AL/CF-TR-1996-0063

ARMSTRONG LABORATORY

IMPACT TESTING OF THE JPATS MANIKINS

John R. Buhrman

CREW SYSTEMS DIRECTORATE
BIODYNAMICS AND BIOCOMMUNICATIONS DIVISION
WRIGHT-PATTERSON AFB, OHIO 45433-7901

JANUARY 1996

Interim Report for the Period February 1995 to May 1995

Approved for public release; distribution is unlimited

AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from the Armstrong Laboratory. Additional copies may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies registered with the Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
8725 John J. Kingman Rd., STE 0944
Ft Belvoir VA 22060-6218

TECHNICAL REVIEW AND APPROVAL

AL/CF-TR-1996-0063

The voluntary informed consent of the subjects in this research was obtained as required by Air Force Instruction 40-402.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE DIRECTOR

Thomas J Moore

THOMAS J. MOORE, Chief
Biodynamics and Biocommunications Division
Crew Systems Directorate
Armstrong Laboratory

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
JANUARY 1996

3. REPORT TYPE AND DATES COVERED
Interim for period Feb 95 to May 95

4. TITLE AND SUBTITLE
Impact Testing of the JPATS Manikins

5. FUNDING NUMBERS
PR - 7184
TA - 718431
WU - 71843101

6. AUTHOR(S)
John R. Buhrman

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Armstrong Laboratory, Crew Systems Directorate
Biodynamics and Biocommunications Division
Human Systems Center
Air Force Materiel Command
Wright-Patterson AFB OH 45433-7901

8. PERFORMING ORGANIZATION REPORT NUMBER
AL/CF-TR-1996-0063

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

One Small and one Large Joint Primary Aircraft Training System (JPATS) manikin along with one Large Advanced Dynamic Anthropomorphic Manikin (ADAM) were exposed to a series of short-duration x, y, and z acceleration pulses on the Armstrong Laboratory Vertical Deceleration Tower and Horizontal Impulse Accelerator. Biodynamic response data from the JPATS manikins were collected and compared with the Large ADAM data as well as with Small ADAM and human subject data from previous tests conducted under identical conditions. The results demonstrated that the JPATS manikins were in general structurally sound, but had serious weaknesses in the neck bracket and knee stops, and some recurring problems in the instrumentation system. Although both JPATS manikins adequately generated and measured most biodynamic responses, the abnormally low force responses of the Small JPATS neck and the Large JPATS lumbar regions were inadequate compared to the other manikins. In addition, large variations in the lumbar and neck responses of both JPATS manikins and inadequate simulation of some x and y-axis human responses should be investigated.

14. SUBJECT TERMS
JPATS manikin, ADAM manikin, acceleration, Biodynamic response, neck force, seat load, lumbar force

15. NUMBER OF PAGES
339

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

THIS PAGE INTENTIONALLY LEFT BLANK

PREFACE

The impact tests and data analysis described in this report were accomplished by the Escape and Impact Protection Branch, Biodynamics and Biocommunications Division of the Armstrong Laboratory (AL/CFBE) at Wright-Patterson Air Force Base, Ohio. The tests were conducted at the request of the Vulnerability Branch (AL/CFBV), which supplied the manikins. Test facility and engineering support were provided by Dyncorp Inc. under contract F33615-91-C-0531. Manikin technical support was provided by Systems Research Laboratories under the Engineering Services Contract.

TABLE OF CONTENTS

PAGE NO.

INTRODUCTION	1
Background	1
Test Objectives	1
METHODS	1
Test Facilities and Equipment	1
Subjects	2
Restraint	3
Instrumentation and Data Processing	4
Motion Analysis Data	4
Experimental Design	4
RESULTS	5
Test-by-Test Narrative	5
Structural Integrity	11
Instrumentation System	11
Biodynamic Response	12
Z-Axis	12
X-Axis	22
Y-Axis	32
DISCUSSION	36
Structural Integrity	36
Instrumentation System	37
Anthropometry	37
Biodynamic Response	37
Comparison of JPATS and ADAM	37
Repeatability of Response	39
Simulation of Human Response	39
CONCLUSIONS	40
REFERENCES	41
APPENDIX A. Test Configuration and Data Acquisition System	42
APPENDIX B. Sample Test Data	146

LIST OF FIGURES

FIGURE		PAGE NO.
1	Small JPATS Manikin	2
2	Large JPATS Manikin	3
3	Head Z Acceleration vs. Carriage Acceleration	18
4	Internal Chest Z Acceleration vs. Carriage . Acceleration	18
5	Pelvis Z Acceleration vs. Carriage . . . . . Acceleration	19
6	Neck Z Force vs. Carriage Acceleration . . .	19
7	Lumbar Z Force vs. Carriage Acceleration . .	20
8	Seat Force vs. Carriage Acceleration	20
9	Neck MY Torque (+) vs. Carriage Acceleration	21
10	Lumbar MY Torque (-) vs. Carriage . . . . . Acceleration	21
11	Seat Z Force vs. Subject Weight (Cell A) . .	22
12	Head X Acceleration vs. Sled Acceleration .	28
13	Internal Chest X Acceleration vs. Sled . . . Acceleration	29
14	Pelvis X Acceleration vs. Sled Acceleration .	29
15	Neck X Force vs. Sled Acceleration	30
16	Lumbar X Force vs. Sled Acceleration	30
17	Neck MY Torque (-) vs. Sled Acceleration . .	31
18	Lumbar MY Torque (+) vs. Sled Acceleration .	31
19	Broken Neck Bracket in Large JPATS Manikin .	36

LIST OF TABLES

TABLE		PAGE NO.
1	Test Matrix	5
2	Structural Inadequacies	11
3	Instrumentation System Malfunctions	12
4	Summary of Z-Axis Peak Acceleration Data at . 10 G (Cell A)	13
5	Summary of Z-Axis Peak Acceleration Data at . 10-24 G (Cell B-E)	14
6	Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10 G (Cell A)	15
7	Mann-Whitney U Tests of JPATS-S vs. ADAM-S at 10 G (Cell B)	15
8	Mann-Whitney U Tests of JPATS-L vs. Human-M at 10 G (Cell A)	16
9	Mann-Whitney U Tests of JPATS-S vs. Human-F at 10 G (Cell A)	16
10	Repeatability of Z-Axis Manikin Dynamic . . . Response at 10 G (Cell A)	17
11	Summary of X-Axis Peak Acceleration Data at . 10 G (Cell J)	23
12	Summary of X-Axis JPATS Peak Acceleration Data at 10-45 G (Cells K-P)	24
13	Summary of X-Axis ADAM Peak Accelertion Data . at 10-45 G (Cells K-O)	24
14	Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10 G (Cell J)	25
15	Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10 G (Cell K)	25
16	Mann-Whitney U Tests of JPATS-S vs. ADAM-S at 10 G (Cell K)	25
17	Mann-Whitney U Tests of JPATS-L vs. Human-M . at 10 G (Cell J)	26
18	Comparison of JPATS-S vs. Human-F at 10 G . . (Cell J)	26
19	Repeatability of Manikin Dynamic Response in X-Axis at 10-20 G (Cells K,L)	27
20	Summary of Y-Axis Peak Acceleration Data at . 7 G (Cell F)	32
21	Summary of Y-Axis Peak Acceleration Data at . 10-14 G (Cells H,I)	33
22	Mann-Whitney U Tests of JPATS-L vs. ADAM-L . at 7 G (Cell F)	33
23	Mann-Whitney U Tests of JPATS-L vs. ADAM-L . at 10 G (Cell H)	34
24	Comparison of JPATS-S vs. ADAM-S at 10 G . . (Cell H)	34
25	Mann-Whitney U Tests of JPATS-L vs. Human-M . at 7 G (Cell F)	35
26	Repeatability of Manikin Dynamic Response in Y-Axis at 7-10 G (Cells F,H)	35

INTRODUCTION

Background

The JPATS (Joint Primary Aircraft Training System) manikins were designed in order to provide the Defense Department with a standardized manikin which could be used to evaluate cockpit ejection biodynamic stresses at levels unsafe for human subject volunteers. One modified 5th percentile female Hybrid III manikin (Small JPATS) and one modified 95th percentile male Hybrid III manikin (Large JPATS) were provided for a series of impact tests at the Escape and Impact Protection Branch of Armstrong Laboratory. Exposures were conducted in the x, y, and z axes. Biodynamic responses were measured and analyzed in order to determine the ability of the manikins to simulate human dynamic response, as well as to measure the manikins' structural integrity and the repeatability of response measurements. The data were compared with the results of concurrent Large ADAM manikin tests and previous Small ADAM and human subject tests which were conducted under identical conditions.

Test Objectives

The objectives of the test program were as follows:

1. To measure the acceleration, loading, and displacement time histories of the JPATS manikins' head and torso when exposed to a wide range of impact accelerations in the x, y, and z axes.

2. To analyze these data in order to evaluate the manikins' structural integrity, instrumentation reliability, impact response repeatability, and simulation of human dynamic response.

3. To compare the JPATS manikins' dynamic response to other manikins in use by the US Air Force, specifically the ADAM manikins.

METHODS

Test Facilities and Equipment

All z-axis tests were conducted on the Armstrong Laboratory Vertical Deceleration Tower (VDT) using plunger 102. Tests in the x and y axes were conducted on the Horizontal Impulse Accelerator (HIA), using pin 11 for Cells F-I and K-L, pin 19 for cells J-J1, and pin 2 for Cells M-P. The acceleration profile on both facilities approximated a half-sine pulse with a 65 ms rise time and 150 ms pulse duration for all cells except J and J1 (120ms / 250ms). All VDT tests used the VIP flat seat with the seat pan parallel to the ground and the seat back parallel to the vertical plane (0°/0°). The HIA tests used the "40G" seat fixture with seat pan and seat back angle of 6°/13° or 13°/13° in the y-axis and 0°/0° or 30°/30° in the x-axis. A 17° wedge fixture was employed in tests requiring the 30°/30° seat angles. The plane of the seat pan and seat back was either flat or contoured as specified in the test matrix below. A

head rest was mounted in-line with the seat back on both seats. Leg and hip side panels were used in y-axis cells F, H, and I only. In x and y axes tests, a flat plate or "skid" was mounted and extended out from the base of the seat fixture to act as a footrest.

Subjects

One Small JPATS manikin (Figure 1) weighing 116 lbs, and one Large JPATS manikin (Figure 2) weighing 248 lbs, were tested in all cells. One Large ADAM manikin weighing 218 lbs (1), was also tested in selected cells as shown in the test matrix. The manikins' limbs were unrestrained with hands folded and resting on the lap in all cells except A, F, and J, where both arms and legs were restrained with the hands placed on the thighs. All manikins wore a standard HGU-55/P flight helmet. An MBU-12/P oxygen mask was employed in all test cells except A, F, J, and J1. The Small ADAM manikin (145 lbs) was not tested in this program, but data taken from previous tests with this manikin under the same conditions were used for comparison.

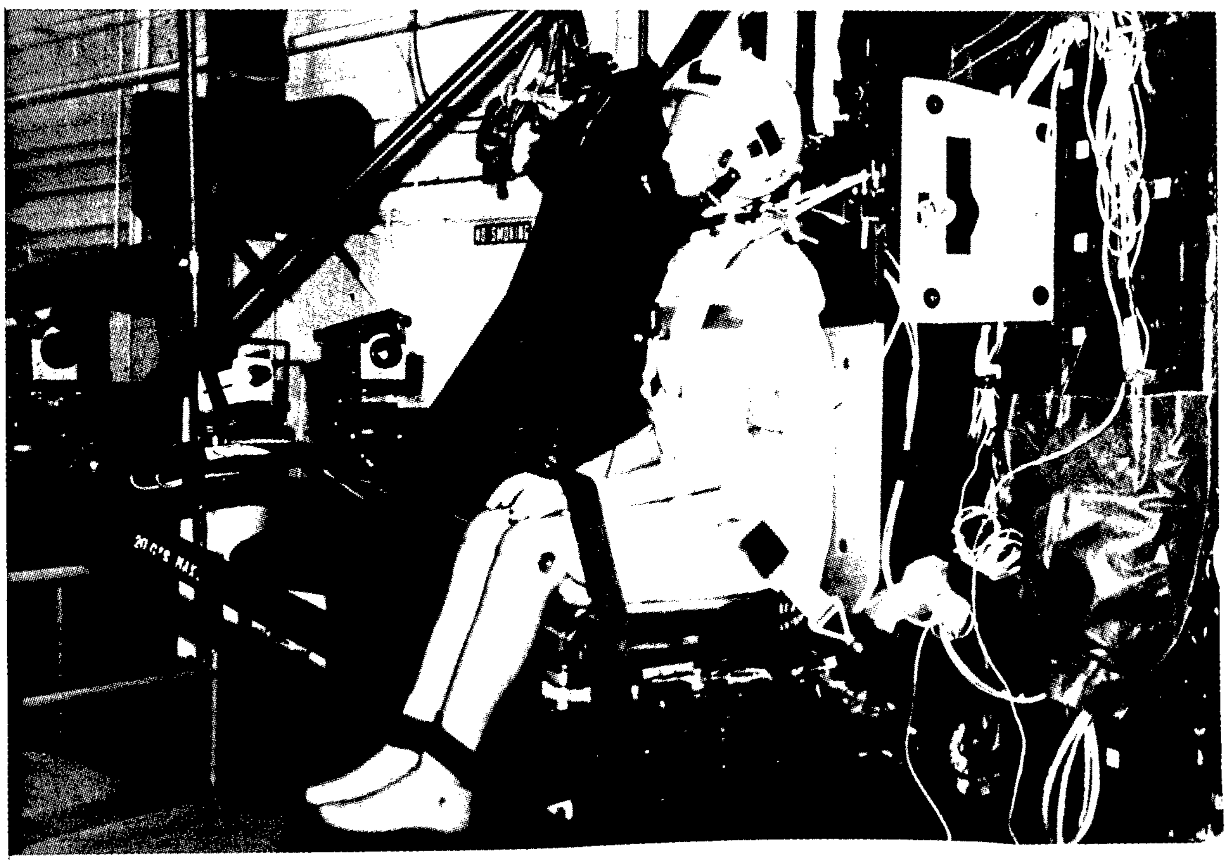


Figure 1. Small JPATS Manikin

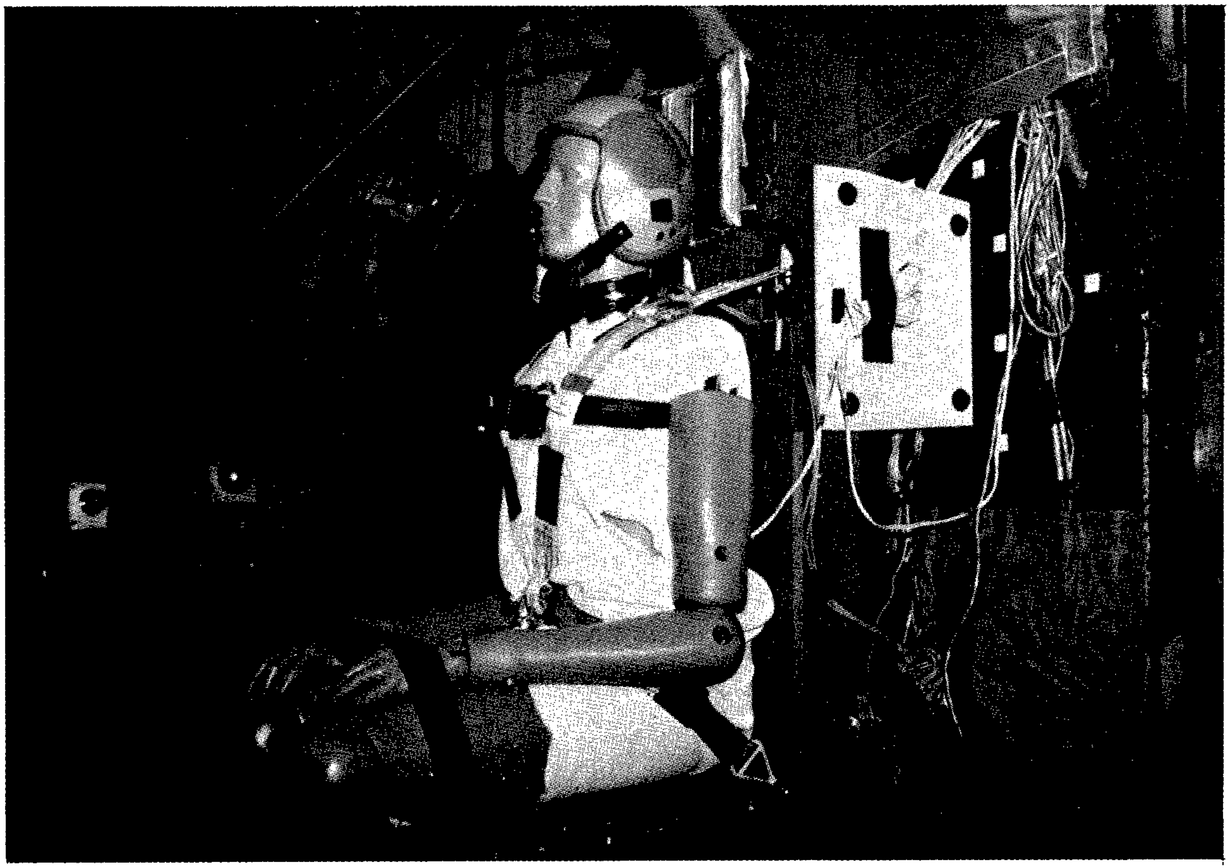


Figure 2. Large JPATS Manikin

Restraint

The manikins were restrained in VDT tests with a double shoulder strap harness and lap belt combination, and in HIA tests with a standard PCU-15 harness and lap belt (large manikin tests) or PCU-16 harness and lap belt (small manikin tests). In VDT tests, the restraint straps for the Small JPATS and Large ADAM were pre-loaded to 20 ± 5 lbs at all attachment points. In VDT tests only, tension for the Large JPATS was increased to 25 ± 5 lbs due to the tendency of the manikin to lean too far forward and to the right. In HIA tests, the restraint straps were pre-loaded to 20 ± 5 lbs at all attachment points for all manikins. An exception was made for the Small JPATS in Cells J and J1 where tensions of 15 ± 5 lbs were employed since the small size of the manikin did not permit the higher tensions to be achieved in this configuration. The shoulder harness was attached to the seat fixture with either a single-v (V), single-t (T), or double (D) attachment configuration as shown in the test matrix.

Instrumentation and Data Processing

Both JPATS manikins contained the following internal transducers: Denton model 1716 six-axis neck load cell, Denton model 1914 six-axis lumbar load cell, Entran model EGV3-F-250 tri-axial head, chest, and pelvis accelerometers, and a chest displacement potentiometer. Both JPATS manikins also contained an external chest accelerometer mounted on an aluminum block and attached by a Velcro strip. The Large ADAM manikin contained all of the same transducers (except the chest displacement potentiometer) along with additional potentiometers which measured displacement of the shoulders, back, hips, and limbs. The test fixture contained load cells which measured lap and shoulder forces during x, y and z axes tests, seat pan loads in z-axis tests, and knee and hip loads in y-axis tests. All transducers were calibrated before and after the test program. Signal amplification, filtering, and temporary storage of the internal manikin data were accomplished by an internal data acquisition system (DAS). The data were collected at 1,000 samples per second and downloaded after each test via a whip cable to a PC computer and then transferred to optical media. All external data were processed and collected by a second DAS mounted on-board the sled. Selected internal and external data channels were plotted for review after each test using a "quick-look" routine. The data was later re-processed in a more complete format for data analysis. A detailed description of the transducers, instrumentation system, and data processing techniques is given in Appendix A.

Motion Analysis Data

Selspot motion analysis data were collected for all tests up to and including sled and carriage levels of 20 G. The data were collected using two Selspot infrared detection cameras that recorded the position of infrared markers at 500 samples per second. The cameras were secured on special mounts attached to the carriage or sled at right and oblique angles to the manikin. Processed Selspot data consisted of relative displacement curves, and displacement and velocity time histories. In addition to the Selspot cameras, a single Kodak high-speed video camera was secured to the carriage or sled camera mount and used for visual documentation of the impact event. For tests greater than 20 G, the Kodak system was positioned off-board. Still documentation photographs were taken before each test and post-test photos were taken when requested by the Test Conductor.

Experimental Design

Small JPATS, Large JPATS, and Large ADAM manikin impact tests were conducted on the VDT in the z-axis (+Gz), and on the HIA in the x and y axes (-Gx and +Gy). Acceleration input levels were varied from 10 to 24 G in the z-axis, 7 to 14 G in the y-axis, and 10 to 45 G in the x-axis. All cells employed an input pulse with 65 ms rise-time and 150 ms pulse duration (except cells J and J1, 120/250 ms). Several other parameters were varied in order to ensure that the JPATS manikin tests were performed under conditions identical to previous human and ADAM manikin tests. These variables included the seat contour, seat pan/back angle, harness attachment point, use of oxygen mask, limb restraint, and employment of restraint side panels. The test matrix below lists all test cells and their parameters.

Table 1. Test Matrix

Test Cell	Accel Axis	Peak Accel	Time (ms)	Seat Plane	Seat Angle°	Harness Attach	O_2 Mask	Limb Restr't	Side Panels
A	+Z	10 G	65/150	Flat	0/0	T	N	Y	N
B	+Z	10 G	65/150	Flat	0/0	V	Y	N	N
C	+Z	15 G	65/150	Flat	0/0	V	Y	N	N
D	+Z	20 G	65/150	Flat	0/0	V	Y	N	N
E	+Z	24 G	65/150	Flat	0/0	V	Y	N	N
F	+Y	7 G	65/150	Flat	6/13	D	N	Y	Y
G1	+Y	6 G	65/150	Contour	13/13	V	Y	N	N
G	+Y	8 G	65/150	Contour	13/13	V	Y	N	N
H	+Y	10 G	65/150	Contour	13/13	V	Y	N	Y
I	+Y	14 G	65/150	Contour	13/13	V	Y	N	Y
J	-X	10 G	120/150	Flat	0/0	D	N	Y	N
J1	-X	10 G	120/150	Flat	0/0	D	N	N	N
K	-X	10 G	65/150	Contour	30/30	V	Y	N	N
L	-X	20 G	65/150	Contour	30/30	V	Y	N	N
M	-X	30 G	65/150	Contour	30/30	V	Y	N	N
N	-X	35 G	65/150	Contour	30/30	V	Y	N	N
O	-X	45 G	65/150	Contour	30/30	V	Y	N	N
P	-X	40 G	65/150	Contour	30/30	V	Y	N	N

RESULTS

Test-by-Test Narrative

TEST 3329: JPATS-S CELL C
TEST 3330: JPATS-S CELL C
TEST 3331: JPATS-S CELL C
TEST 3332: JPATS-S CELL D
Event marker triggered at impact (internal DAS failure), data later recovered.
TEST 3333: JPATS-S CELL D
TEST 3334: JPATS-S CELL D
Event marker misplaced in data - DAS instructed all channels (bin file) to change sample rate during third period, data later recovered
* TEST 3335: JPATS-S CELL B
Carriage peak acceleration too high at 10.58 - test was to be rerun.
TEST 3336: JPATS-S CELL B
TEST 3337: JPATS-S CELL B
TEST 3338: JPATS-S CELL B
TEST 3339: JPATS-S CELL B
TEST 3340: JPATS-S CELL B
TEST 3341: JPATS-S CELL A
TEST 3342: JPATS-S CELL A

TEST 3343: JPATS-S CELL A
TEST 3344: JPATS-S CELL A
TEST 3345: JPATS-S CELL A
False trigger prior to test.
* TEST 3346: JPATS-S CELL B
No triggering of DAS due to low batteries - no data.
* TEST 3347: JPATS-S CELL B
Battery impact test only - no data collected.
* TEST 3348: JPATS-S CELL E
Power line to internal DAS was broken during impact - no data.
TEST 3349: JPATS-S CELL E
Event marker misplaced in data (bin file corrected, data OK). After test, event channels in internal DAS were grounded to correct problem.
* TEST 3350: JPATS-S CELL E
All channels went dead at impact - no usable data collected.
TEST 3351: JPATS-S CELL E
No Pelvic Y Acceleration data.
TEST 3352: JPATS-S CELL E
* TEST 3353: JPATS-S CELL C
DAS would not arm prior to test due to bad connector in DAS - no data.
* TEST 3354: JPATS-L CELL C
Pre-loads were 20 lbs ± 5 lbs
TEST 3355: JPATS-L CELL C
Pre-loads increased to 25 ± 5 lbs due to manikin leaning too far forward and to the right. Helmet still 1" out of headrest on manikin's left. Selspot reliability factor too high on all JPATS-L tests.
TEST 3356: JPATS-L CELL C
Helmet now closer to headrest.
TEST 3357: JPATS-L CELL C
TEST 3358: JPATS-L CELL D
TEST 3359: JPATS-L CELL D
TEST 3360: JPATS-L CELL B
TEST 3361: JPATS-L CELL B
TEST 3362: JPATS-L CELL B
TEST 3363: JPATS-L CELL B
TEST 3364: JPATS-L CELL B
TEST 3365: JPATS-L CELL B
TEST 3366: JPATS-L CELL A
TEST 3367: JPATS-L CELL A
TEST 3368: JPATS-L CELL A
TEST 3369: JPATS-L CELL A
Left lower leg was loose at upper joint after test.
TEST 3370: JPATS-L CELL A
TEST 3371: JPATS-L CELL D
Battery system discharged prior to test, external power supply was used for test. Left

lower leg was tightened prior to test.
TEST 3372: JPATS-L CELL E
TEST 3373: JPATS-L CELL E
TEST 3374: JPATS-L CELL E
TEST 3400: ADAM-L CELL A
This test was run on 9 Mar, tests 3401-3405 were run on 13
TEST 3401: ADAM-L CELL A
TEST 3402: ADAM-L CELL A
TEST 3403: ADAM-L CELL A
TEST 3404: ADAM-L CELL A
TEST 3405: ADAM-L CELL A
* TEST 5218: JPATS-L CELL F
Profile test, no data collected.
* TEST 5219: JPATS-L CELL F
No data collected due to incorrect wiring which resulted in no triggering at impact.
* TEST 5220: JPATS-S CELL F
Preload at right shoulder was low at 10 lbs. Head Z and Pelvis Y Acceleration channels bad.
TEST 5221: JPATS-S CELL F
Shoulder harness attachments to load cell brackets were moved inward to accommodate the narrow shoulders. No Chest Y Acceleration data collected due to loose 4-pin connector between the chest accelerometer and the DAS. This test was repeated.
TEST 5222: JPATS-S CELL F
Kodak slow-motion film system did not operate.
* TEST 5223: JPATS-S CELL F
No data due to low batteries (9 volts). Next four tests were run without batteries.
TEST 5224: JPATS-S CELL F
TEST 5225: JPATS-S CELL F
External data from tests 5225-5237 were accidentally deleted by operator.
TEST 5226: JPATS-S CELL F
TEST 5227: JPATS-S CELL F
TEST 5228: ADAM-L CELL F
TEST 5229: ADAM-L CELL F
TEST 5230: ADAM-L CELL F
Event marker (ch 61) was not properly inserted in the ADAM data. Marker was inserted later using the external DAS.
TEST 5231: ADAM-L CELL F
TEST 5232: ADAM-L CELL F
TEST 5233: JPATS-L CELL F
The DAS was replaced with the one from JPATS-S. Restraints were moved from hands to the wrists and kept fairly loose.
TEST 5234: JPATS-L CELL F
TEST 5235: JPATS-L CELL F
TEST 5236: JPATS-L CELL F
TEST 5237: JPATS-L CELL F

TEST 5238: JPATS-L CELL F
TEST 5239: ADAM-L CELL H
Event marker again not properly inserted in ADAM data (switched from ch 61 to 62).
TEST 5240: JPATS-L CELL H
Felt padding was taped to side of headrest due to severe whiplash of helmet. Battery voltage was low (13 volts) after test, so switched to external power for next test. Original DAS was placed back into manikin prior to test.
TEST 5241: JPATS-L CELL H
TEST 5242: JPATS-L CELL H
TEST 5243: JPATS-L CELL H
TEST 5244: JPATS-L CELL H
TEST 5245: ADAM-L CELL H
Event marker still not being properly inserted in ADAM data (ch 62), switched to ch 9 and still not working properly. ADAM head was measured at 3" from back of headrest.
TEST 5246: ADAM-L CELL H
TEST 5247: ADAM-L CELL H
TEST 5248: ADAM-L CELL H
TEST 5249: ADAM-L CELL H
* TEST 5250: JPATS-S CELL H
Peak sled acceleration too high at 10.53 G. Test will be repeated.
TEST 5251: JPATS-S CELL H
TEST 5252: JPATS-S CELL H
Neck appeared a little loose - tightened after test.
TEST 5253: JPATS-S CELL H
TEST 5254: JPATS-S CELL H
Manikin head is still loose.
TEST 5255: JPATS-S CELL H
* TEST 5256: JPATS-S CELL I
Prior to test, neck cable and screw were tightened. Batteries low although charged the day before test, no data collected.
TEST 5257: JPATS-S CELL I
No Kodak low-motion video.
TEST 5258: JPATS-S CELL I
TEST 5259: JPATS-S CELL I
TEST 5260: ADAM-L CELL I
Thicker foam taped to side of headrest.
TEST 5261: ADAM-L CELL I
TEST 5262: ADAM-L CELL I
Spike in data on most ADAM channels.
TEST 5263: ADAM-L CELL I
ADAM DAS continued to collect data after impact. Crack was discovered in footrest.
TEST 5264: ADAM-L CELL I
TEST 5265: ADAM-L CELL I
TEST 5266: ADAM-L CELL G1
TEST 5267: ADAM-L CELL G

TEST 5268: ADAM-L CELL G
* TEST 5269: ADAM-L CELL J
Profile test - data collected but sled acceleration level high at 10.53 G.
TEST 5270: ADAM-L CELL J
TEST 5271: ADAM-L CELL J1
No limb restraint used for this cell.
TEST 5272: ADAM-L CELL J
TEST 5273: ADAM-L CELL J
TEST 5274: ADAM-L CELL J
TEST 5275: ADAM-L CELL J
TEST 5276: ADAM-L CELL J
TEST 5277: JPATS-S CELL J
No data triggering in JPATS-L so switched to JPATS-S for test. Shoulder loads 15 ± 5 lbs for all JPATS-S tests in this cell only.
TEST 5278: JPATS-S CELL J
TEST 5279: JPATS-S CELL J
TEST 5280: JPATS-S CELL J
TEST 5281: JPATS-L CELL J
DAS would not initially trigger prior to test.
TEST 5282: JPATS-L CELL J
TEST 5283: JPATS-L CELL J
TEST 5284: JPATS-L CELL J
DAS triggered prematurely during pressurization, was reset and re-triggered.
TEST 5285: JPATS-L CELL J
TEST 5286: JPATS-S CELL J
* TEST 5312: JPATS-L CELL K
Profile test - data collected but sled acceleration level high at 10.44 G.
TEST 5313: JPATS-L CELL K
TEST 5314: JPATS-L CELL K
Battery connection preventing triggering of DAS prior to test. It was disconnected and external power used.
TEST 5315: JPATS-L CELL K
TEST 5316: JPATS-L CELL K
TEST 5317: JPATS-L CELL K
TEST 5318: ADAM-L CELL K
TEST 5319: ADAM-L CELL K
TEST 5320: ADAM-L CELL K
TEST 5321: ADAM-L CELL K
TEST 5322: ADAM-L CELL K
TEST 5323: JPATS-S CELL K
TEST 5324: JPATS-S CELL K
TEST 5325: JPATS-S CELL K
TEST 5326: JPATS-S CELL K
TEST 5327: JPATS-S CELL K
* TEST 5328: JPATS-S CELL L

Profile test - data collected but peak acceleration too high at 21.64 G. Pelvis Y Acceleration data bad, manikin taken out of seat for repair.

* TEST 5329: JPATS-L CELL L

Stitching in webbing which connects shoulder harness to load cells broke during impact. Test will be repeated.

TEST 5330: JPATS-S CELL L

TEST 5331: JPATS-S CELL L

TEST 5332: JPATS-S CELL L

New stitching again starting to come loose on connecting webbing.

TEST 5333: JPATS-S CELL L

TEST 5334: JPATS-S CELL L

External Chest X Acceleration channel bad. An additional strap was employed loosely around chest for added safety. This strap will be used in all remaining manikin tests.

TEST 5335: JPATS-L CELL L

New connecting webbing with new stitching was employed prior to test.

TEST 5336: ADAM-L CELL L

JPATS-L not triggering prior to test due to broken wire, switched to ADAM-L for test.

TEST 5337: ADAM-L CELL L

TEST 5338: ADAM-L CELL L

TEST 5339: JPATS-L CELL L

TEST 5340: JPATS-L CELL L

TEST 5341: JPATS-L CELL L

False trigger in manikin prior to test.

TEST 5342: JPATS-L CELL L

TEST 5343: JPATS-L CELL L

Broken stop discovered in right kneecap after test.

TEST 5344: ADAM-L CELL M

Front part of neck bracket was sheared off during impact. No Neck Moment data due to loose connector. DAS would not power back up after test, so data was downloaded using external power supply.

TEST 5345: ADAM-L CELL M

Distance from helmet to back of headrest was measured at 3 7/8". Foam was added to back of headrest to prevent helmet damage from whiplash.

TEST 5346: ADAM-L CELL M

TEST 5347: JPATS-S CELL M

TEST 5348: JPATS-S CELL M

TEST 5349: JPATS-S CELL M

TEST 5350: JPATS-S CELL N

Head again loose after test - bolt pulled out of insert in neck bracket. New bracket installed prior to next test. External chest accelerometer went bad - it will not be used in remainder of tests.

TEST 5351: JPATS-L CELL M

Neck bracket completely sheared off during impact, causing head to come off. Also knee stops came off during test.

TEST 5352: JPATS-S CELL N

Bolt loosened and pulled slightly out of neck bracket during impact. Neck bracket also appeared to have surface stress damage. No force or moment data from neck load cell in x and y axes. Load cell checked OK after test so was not repaired. Lumbar X Force data bad.

* TEST 5353: VIP-95 CELL P
Profile test.

TEST 5354: JPATS-S CELL P
A loose cloth head strap was employed for the remaining tests to provide some head support during impact. No oxygen mask was used during the tests to allow the strap to be wrapped around the head. However, the neck bolt again partially pulled out of its insert during impact. One minute prior to start of test, the DAS stopped collecting data due to a defective cell in the internal battery pack, so the system was switched to the external power supply. Neck force and moment data were collected OK this time.

TEST 5355: JPATS-S CELL O
Neck bolt again stripped from insert during test.

---

* Results from these tests were not used in data analysis

Structural Integrity

Significant structural problems occurred in the neck bracket of both the Large and Small JPATS manikins and in the knee stops of the Small JPATS. Table 2 is a summary of all significant structural problems discovered upon post-test inspections of the manikins:

Table 2. Structural Inadequacies

Manikin	Cells	Problem	No. Occurrences
JPATS-S	H	Neck loosened slightly	1
JPATS-S	M,N,O, P	Neck bracket pulled partially out of its fitting	4
JPATS-L	A	Left lower leg loosened at hip joint	1
JPATS-L	L,M	Broken or loose knee stops	2
JPATS-L	M	Neck bracket completely sheared off	1
ADAM-L	M	Front part of neck bracket sheared off	1

Instrumentation System

Problems with the instrumentation system occurred in the areas of data collection, event marker insertion, broken wires, and weak or faulty battery system. Table 3 is a summary of malfunctions in the manikin instrumentation and data collection hardware and software.

Table 3. Instrumentation System Malfunctions

Manikin	Cells	Problem	No. Occurrences
JPATS-S	A,C	Premature or no data collection triggering in DAS	2
JPATS-S	B,F,I,P	Battery system discharge	4
JPATS-S	D,E	Event marker misplaced by DAS	3
JPATS-S	E	DAS stopped collecting data at impact	2
JPATS-S	E,F,L,N	Bad individual channel data	7
JPATS-L	F,J,L,K	Premature or no data collection triggering in DAS	7
JPATS-L	D,H	Battery system discharge	2
ADAM-L	F,H	Event marker misplaced by DAS	3
ADAM-L	I	Spike in data on most channels	1
ADAM-L	I	DAS continued to collect data after impact	1

Biodynamic Response

Z-Axis

Manikin Comparisons: Complete z-axis biodynamic response data are given in Tables 4 and 5. Mann-Whitney U tests were performed on the data in Cells A and B in order to compare the mean peak magnitudes of the JPATS and ADAM manikins' responses at 10 G carriage acceleration. The results are shown in Tables 6 and 7. Peak magnitudes of all Large JPATS measurements in Cell A were within 10% of the Large ADAM measurements with the exceptions of the pelvis acceleration (-14.6%), neck torque (-22.3%) and lumbar torque (+64.6%). In Cell B, Small JPATS head acceleration (-13.1%), chest acceleration (-11.5%), seat force (-21.9%) and neck force (-27.4%) were all lower than in the Small ADAM, while the lumbar force (+174%) and neck torque (+86.4%) were substantially higher.

Table 4. Summary of Z-Axis Peak Acceleration Data at 10G (Cell A)

	JPATS-S		JPATS-L		ADAM-L	
Channel	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)
Carriage Z Accel (G)	10.01 ± .06	66.6 ± 1.9	10.00 ± 0.07	65.8 ± 0.8	9.86 ± 0.07	66.3 ± 1.8
Head Z Accel (G)	12.31 ± 0.46	72.2 ± 4.9	12.82 ± 0.42	73.6 ± 3.2	13.83 ± 0.57	77.3 ± 2.5
Ext Chest Z Accel (G)	15.21 ± 1.78	75.2 ± 2.6	16.03 ± .78	76.8 ± 1.6	14.64 ± 1.10	79.0 ± 1.5
Int Chest Z Accel (G)	12.43 ± 0.40	73.6 ± 2.7	13.23 ± 0.07	73.6 ± 2.1	14.16 ± 0.57	77.8 ± 2.3
Pelvis Z Accel (G)	11.92 ± 0.24	71.8 ± 1.8	11.58 ± 0.16	72.2 ± 0.4	13.56 ± 0.84	70.2 ± 2.9
Neck Z Force (LBS)	113.0 ± 5.76	72.4 ± 4.8	150.2 ± 5.19	72.0 ± 1.9	148.9 ± 5.92	77.5 ± 2.7
Lumbar Z Force (LBS)	725.1 ± 40.4	73.8 ± 1.8	1115 ± 23.9	76.2 ± 1.3	1099 ± 25.6	75.2 ± 4.1
Seat Z Force (LBS)	1390 ± 84.8	73.6 ± 1.7	2940 ± 60.5	75.0 ± 2.4	2764 ± 72.5	72.2 ± 2.8
Neck MY Torque (-) (IN-LBS)	31.84 ± 7.95	113.0 ± 7.3	85.13 ± 4.33	107.8 ± 1.3	109.6 ± 10.03	133.0 ± 1.79
Lumbar MY Torque (-) (IN-LBS)	418.4 ± 60.8	73.8 ± 7.2	1102 ± 148	78.2 ± 4.2	669.6 ± 60.8	83.8 ± 2.1

Table 5. Summary of Z-Axis Peak Acceleration Data at 10-24G (Cells B-E)

	JPATS-S Peak Magnitude				JPATS-L Peak Magnitude			
Channel	10G	15G	20G	24G	10G	15G	20G	24G
Carriage Z Accel (G)	10.18 ± 0.11	15.04 ± 0.08	20.11 ± 0.04	24.25 ± 0.17	10.03 ± 0.09	14.78 ± 0.09	19.60 ± 0.02	23.45 ± 0.10
Head Z Accel (G)	11.68 ± 0.13	22.63 ± 0.68	30.84 ± 0.28	37.47 ± 1.08	12.80 ± 0.49	22.91 ± 2.22	29.82 ± 0.53	40.16 ± 1.19
Ext Chest Z Accel (G)	14.40 ± 1.01	37.66 ± 4.70	47.71 ± 3.15	54.64 ± 5.36	16.26 ± 1.67	34.39 ± 3.04	43.84 ± 6.02	41.99 ± 5.41
Int Chest Z Accel (G)	12.15 ± 0.25	22.69 ± 0.90	31.02 ± 0.28	38.54 ± 1.30	13.19 ± 0.32	22.51 ± 0.65	32.69 ± 0.48	43.26 ± 1.18
Pelvis Z Accel (G)	11.91 ± 0.26	21.02 ± 1.02	28.18 ± 1.16	33.91 ± 1.79	11.40 ± 0.37	19.05 ± 0.13	27.22 ± 1.17	32.88 ± 1.28
Neck Z Force (LBS)	116.0 ± 3.33	216.5 ± 14.0	306.4 ± 4.58	363.2 ± 13.9	168.9 ± 3.62	284.4 ± 18.2	371.4 ± 5.33	496.9 ± 14.4
Lumbar Z Force (LBS)	711.5 ± 13.31	1281 ± 40.3	1775 ± 26.6	2125 ± 32.3	1121 ± 37.6	1877 ± 59.3	2426 ± 67.3	3081 ± 39.3
Seat Z Force (LBS)	1347 ± 14.2	2312 ± 30.8	3309 ± 52.9	4152 ± 33.4	3044 ± 92.6	4861 ± 5.64	6677 ± 92.1	8368 ± 91.3
Neck MY Torque (+) (IN-LBS)	61.64 ± 4.43	125.7 ± 15.6	176.2 ± 13.6	224.5 ± 11.6	108.4 ± 4.43	173.6 ± 14.8	178.8 ± 7.19	210.3 ± 0.54
Lumbar MY Torque (-) (IN-LBS)	546.0 ± 66.7	689.5 ± 135	1027 ± 134	1161 ± 44.8	1285 ± 155	1880 ± 121	2529 ± 408	3089 ± 3.03

	ADAM-S Peak Magnitude			
Channel	10G	15G	20G	24G
Carriage Z Accel (G)	9.92 ± 0.05	15.21 ± 0.03	20.09 ± 0.12	23.99 ± 0.17
Head Z Accel (G)	13.44 ± 0.62	23.58 ± 0.97	33.15 ± 1.50	42.18 ± 1.65
Ext Chest Z Accel (G)	14.30 ± 0.70	27.49 ± 1.19	38.59 ± 1.40	49.16 ± 1.50
Int Chest Z Accel (G)	13.73 ± 0.83	23.08 ± 1.18	32.83 ± 1.43	40.12 ± 2.24
Neck Z Force (LBS)	159.8 ± 7.20	276.9 ± 11.5	384.6 ± 10.7	474.7 ± 20.7
Lumbar Z Force (LBS)	259.9 ± 17.0	402.3 ± 5.88	588.7 ± 35.4	747.0 ± 36.5
Seat Z Force (LBS)	1724 ± 77.7	2791 ± 134	3957 ± 161	4883 ± 95.0
Neck MY Torque (+) (IN-LBS)	33.06 ± 14.5	44.37 ± 16.6	65.65 ± 13.8	74.57* ± 0.00

*One test only

Table 6. Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10G (Cell A)

Channel	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude	% Difference
Head Z Accel (G)	12.82	13.83	-7.3%
Int Chest Z Accel (G)	13.23	14.16	-6.6%
Pelvis Z Accel (G)	11.58	13.56	-14.6%
Neck Z Force (LBS)	150.2	148.9	NSD
Lumbar Z Force (LBS)	1115	1099	NSD
Seat Z Force (LBS)	2940	2764	+6.4%
Neck MY Torque (IN-LBS)	85.13	109.6	-22.3%
Lumbar MY Torque (IN-LBS)	1102	669.6	+64.6%

Table 7. Mann-Whitney U Tests Of JPATS-S vs. ADAM-S at 10G (Cell B)

Channel	JPATS-S Peak Magnitude	ADAM-S Peak Magnitude	% Difference
Head Z Accel (G)	11.68	13.44	-13.1%
Chest Z Accel (G)	12.15	13.73	-11.5%
Neck Z Force (LBS)	116.0	159.8	-27.4%
Lumbar Z Force (LBS)	711.5	259.9	+174%
Seat Z Force (LBS)	1347	1724	-21.9%
Neck MY Torque (IN-LBS)	61.64	33.06	+86.4%

Simulation of Human Response: Tables 8 and 9 give the results of Mann-Whitney U tests which were used to compare the JPATS manikins' mean peak responses in cell A to data collected during human impact tests run under identical conditions. The Large JPATS peak magnitudes and time-to-peak measurements of head and chest accelerations were very close to the corresponding human male responses. In comparisons between the Small JPATS and human female subjects, the head acceleration and time-to-peak measurements were almost identical between the two groups, while the Small JPATS external chest acceleration measured slightly higher (+14.4%) with a slightly shorter time-to-peak response (-10.7%) than the human female subjects.

Table 8. Mann-Whitney U Tests of JPATS-L vs. Human-M at 10G (Cell A)

Channel	JPATS-L Peak Magnitude	HUMAN-M Peak Magnitude	% Difference
Head Z Accel (G)	12.82	14.13	NSD
Ext Chest Z Accel (G)	16.03	14.54	NSD

Channel	JPATS-L Time-to-Peak	HUMAN-M Time-to-Peak	% Difference
Head Z Accel (MS)	73.6	74.5	NSD
Ext Chest Z Accel (MS)	76.8	80.8	NSD

Table 9. Mann-Whitney U Tests of JPATS-S vs. Human-F at 10G (Cell A)

Channel	JPATS-S Peak Magnitude	HUMAN-F Peak Magnitude	% Difference
Head Z Accel (G)	12.31	12.07	NSD
Ext Chest Z Accel (G)	15.21	13.29	+ 14.4%

Channel	JPATS-S Time-to-Peak	HUMAN-F Time-to-Peak	% Difference
Head Z Accel (MS)	72.2	76.0	NSD
Ext Chest Z Accel (MS)	75.2	84.2	-10.7%

Repeatability: Five consecutive tests run under identical conditions for each manikin were used to demonstrate repeatability. The repeatability values were determined by dividing the sum of two standard deviations of the mean peak response by the mean of that response. This range would be expected to include approximately 95% of all measurements for that response, with low values indicating less variance from the mean. Repeatability results for manikin responses in the z-axis at 10 G are given in Table 10. Repeatability for the Small JPATS manikin was higher on all channels than either the Large JPATS or the Large ADAM, although all three manikins were under ± 12% with the exception of the torque measurements. Neck torque (± 49.9%) and lumbar torque (± 29.1%) repeatability were both very high for the Small JPATS manikin. Lumbar torque repeatability was also high for both the Large JPATS (± 26.9%) and the Large ADAM (± 16.0%).

Table 10. Repeatability of Z-Axis Manikin Dynamic Response at 10G (Cell A)

Channel	JPATS-S Peak Magnitude	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude
Carriage Z Accel (G)	± 1.2%	± 1.4%	± 1.6%
Head Z Accel (G)	± 7.5%	± 6.6%	± 4.7%
Int Chest Z Accel (G)	± 6.4%	± 1.1%	± 4.3%
Pelvis Z Accel (G)	± 4.0%	± 2.8%	± 10.3%
Neck Z Force (LBS)	± 10.2%	± 6.9%	± 6.3%
Lumbar Z Force (LBS)	± 11.1%	± 4.3%	± 4.6%
Seat Z Force (LBS)	± 12.2%	± 4.1%	± 3.9%
Neck MY Torque (IN-LBS)	± 49.9%	± 10.2%	± 8.4%
Lumbar MY Torque (IN-LBS)	± 29.1%	± 26.9%	± 16.0%

Acceleration Plots: Response plots of the JPATS manikins' mean peak magnitudes as a function of increasing carriage acceleration levels for z-axis tests at 10-24 G are shown in Figures 3-10. Data from a previous study using a Small ADAM under identical test conditions were available for most channels and are included in the plots for comparison. Figures 3-5 show that the head, internal chest, and pelvis acceleration peak responses were all tightly clustered and increase linearly with increasing carriage acceleration in all three manikins. Figures 6-10 show manikin peak response plots of the forces and torques for the same three manikins. The Large JPATS manikin generated substantially larger seat forces than the other two manikins, and the Small JPATS generated much smaller neck forces. In the lumbar force plots, the Large JPATS again generated the largest peak forces while the Small ADAM generated the lowest forces with a flatter slope than either JPATS manikin. Neck Torque (positive peak) increased steeply in both JPATS manikins, but flattened out at 20-25 G in the Large JPATS. The Small ADAM, however, demonstrated only slightly increasing neck torque with a much flatter slope. The Large JPATS manikin generated larger lumbar torques with a steeper slope than the Small JPATS (no data was available for the Small ADAM in this channel).

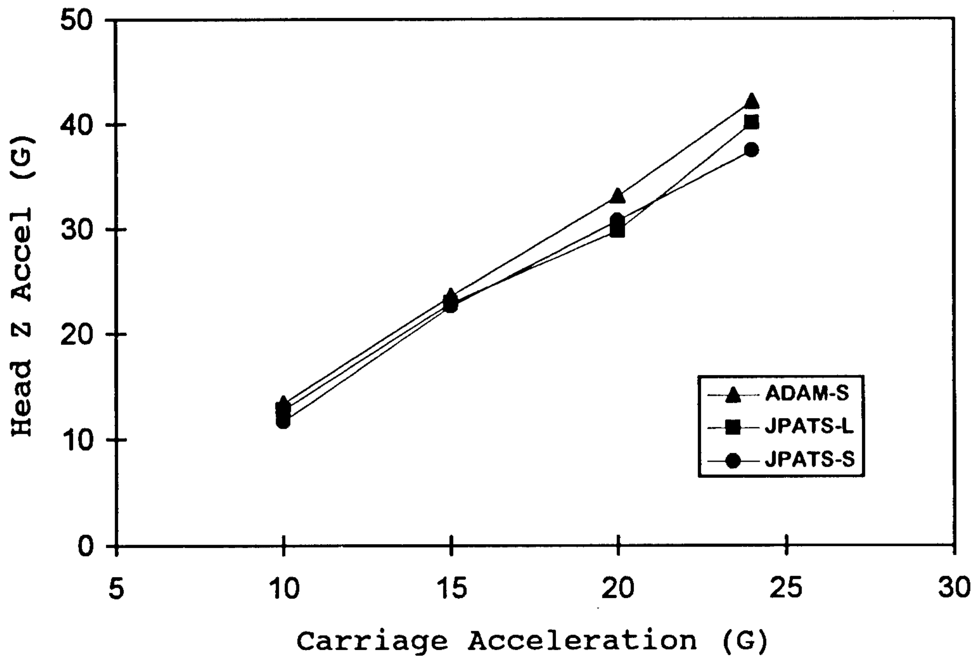


Fig 3. Head Z Acceleration vs. Carriage Acceleration

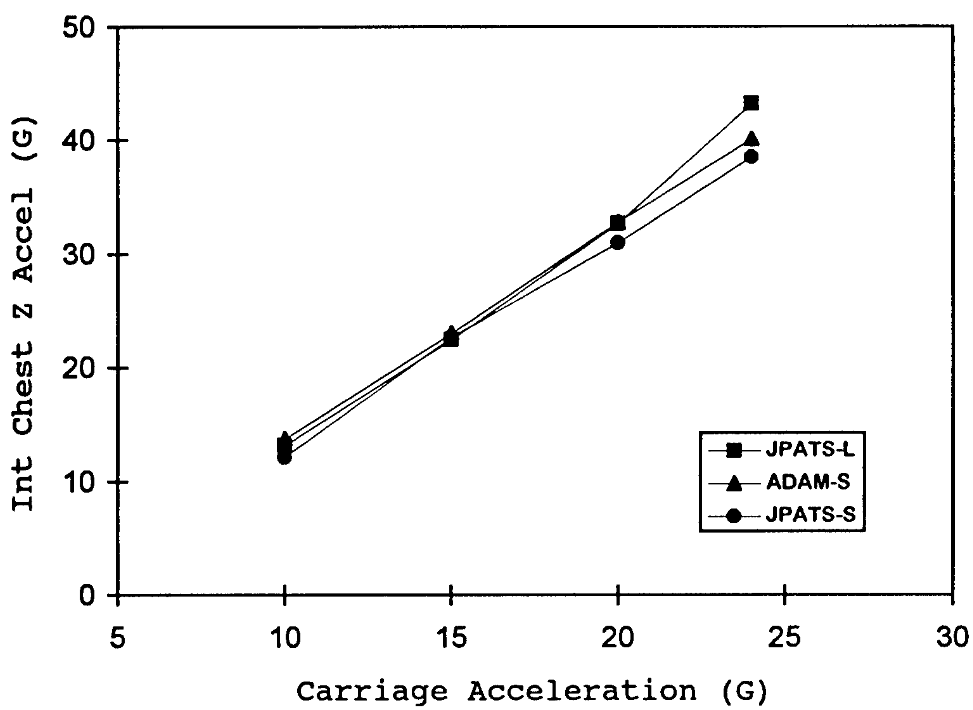


Fig 4. Internal Chest Z Acceleration vs. Carriage Acceleration

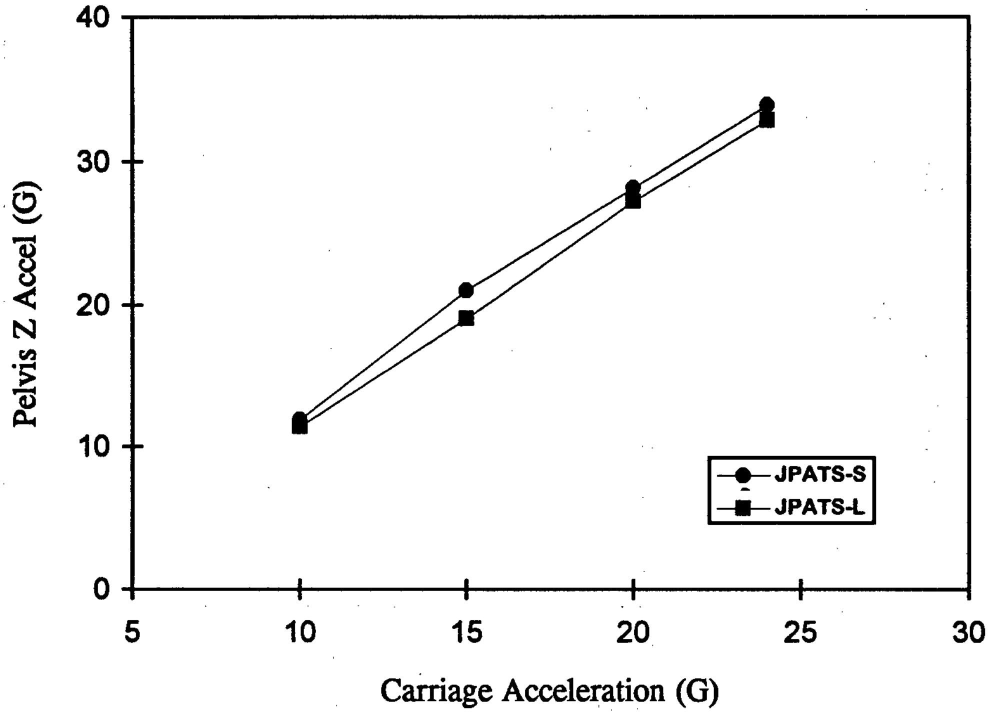


Fig 5. Pelvis Z Acceleration vs. Carriage Acceleration

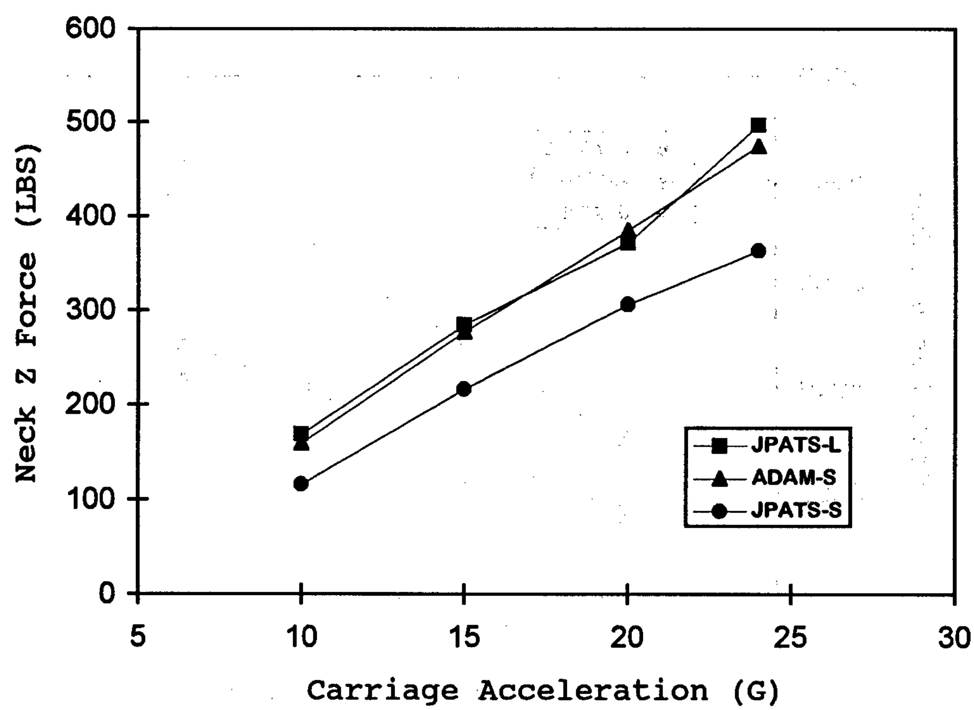


Fig 6. Neck Z Force vs. Carriage Acceleration

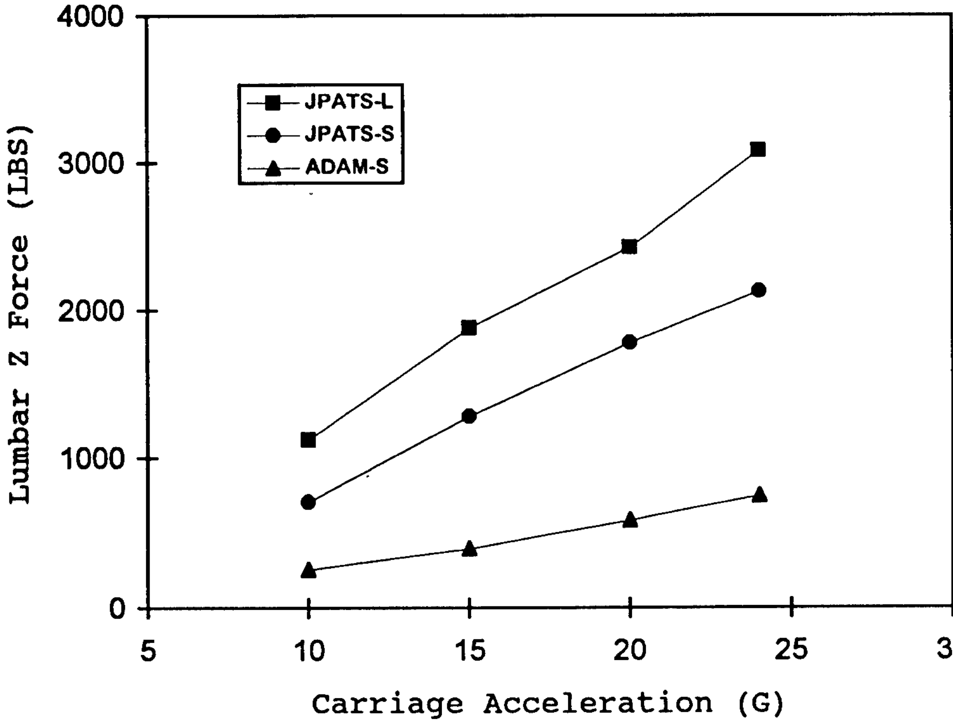


Fig 7. Lumbar Z Force vs. Carriage Acceleration

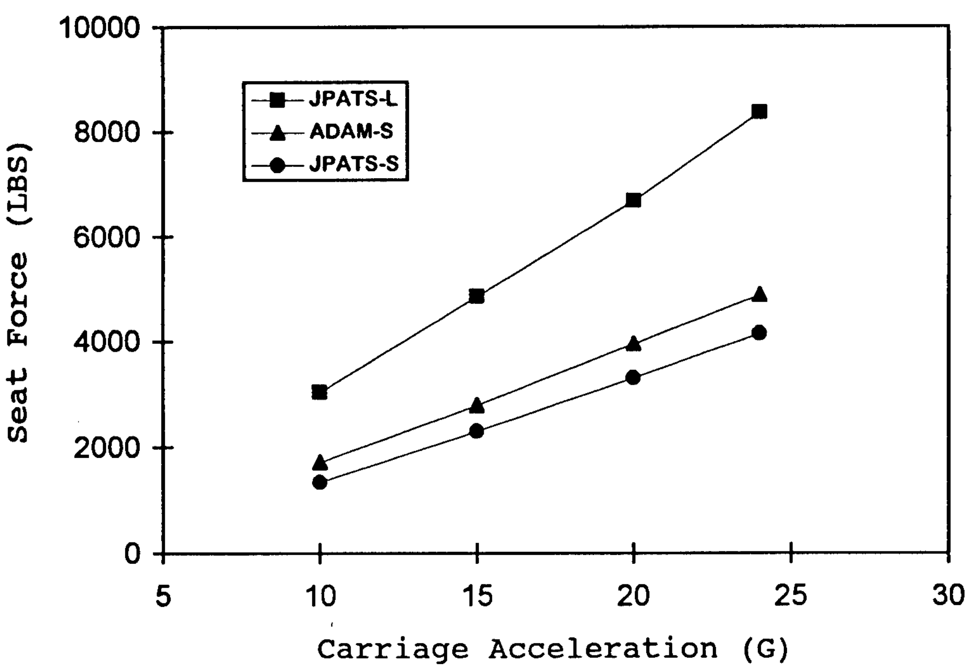


Fig 8. Seat Force vs. Carriage Acceleration

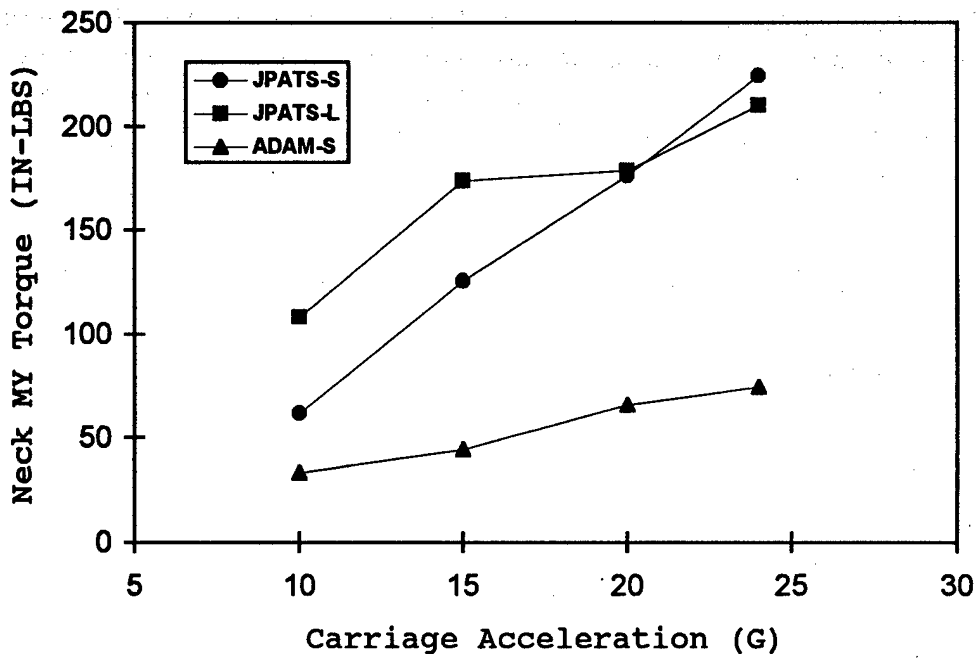


Fig 9. Neck MY Torque (+) vs. Carriage Acceleration

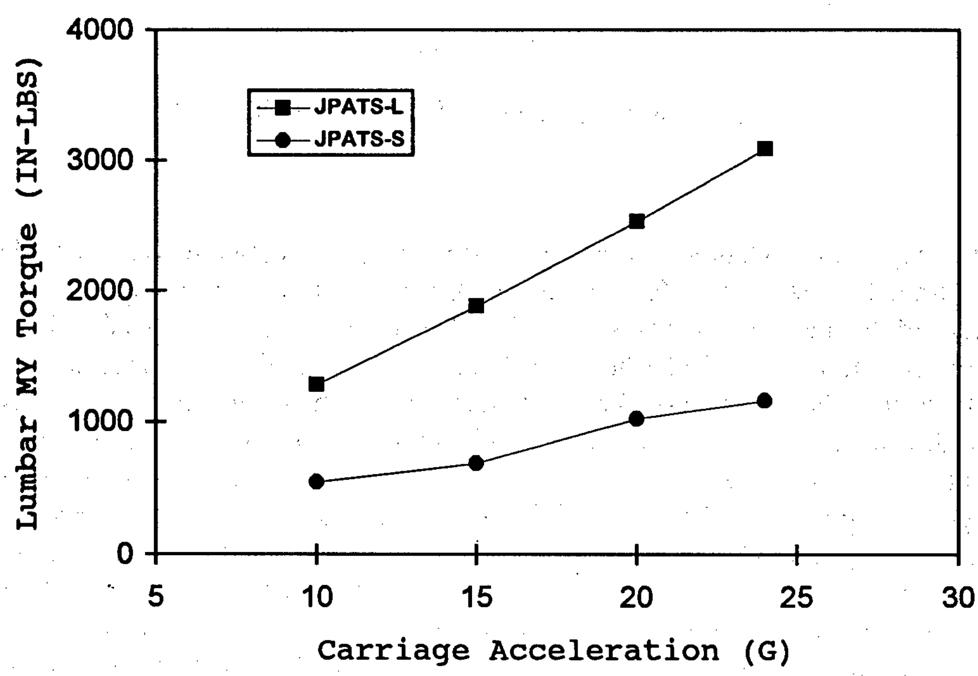


Fig 10. Lumbar MY Torque (-) vs. Carriage Acceleration

Seat Forces: Seat force peak magnitude response data at 10 G were plotted in Figure 11 for all manikins according to their weight and placed about a regression line of human subject data. Ninety-five percent confidence intervals were also plotted for the human data. The Small JPATS and Small ADAM forces are almost identical to the human peak forces at their respective weights, while the Large JPATS and Large ADAM forces are slightly larger than predicted by the human data regression line.

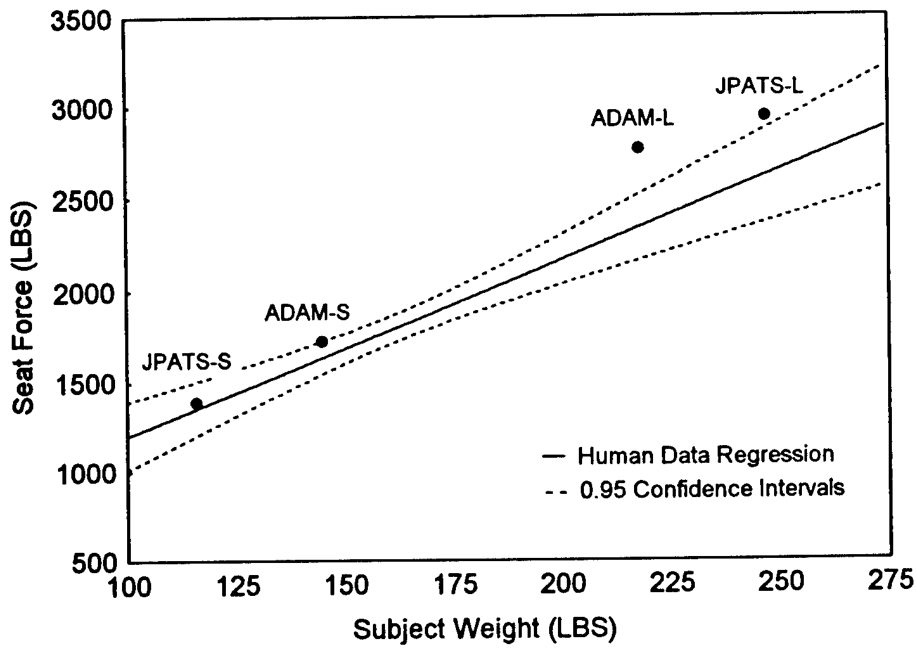


Fig 11. Seat Z Force vs. Subject Weight (Cell A)

X-Axis:

Manikin Comparisons: Complete x-axis biodynamic response data are given in Tables 11-13. Mann-Whitney U tests were performed on cells J, K and L in order to compare the mean peak magnitudes of the manikin responses at 10 G sled acceleration, with the results given in Tables 14-16. In cell J, the Large JPATS head acceleration and internal chest acceleration were nearly identical to the Large ADAM measurements, while the pelvis acceleration was slightly larger (+13.8%). The neck force (+42.9%) and lumbar torque (+47.0%) were both significantly larger in the Large JPATS. Both the lumbar force and neck torque responses were opposite in polarity in the two manikins in this cell and could not be directly compared. In cell K, the Large JPATS head, internal chest, and pelvis accelerations were within 11% of the Large ADAM responses. The lumbar force (-58.3%) and neck torque (-50.5%) were substantially lower in the Large JPATS, while the neck force (+38.9%) and lumbar torque (+50.3%) were much larger. In cell K comparisons between the Small JPATS and Small ADAM, there were no significant differences in either the head acceleration or the neck force. The Small JPATS internal chest acceleration was slightly larger (+12.8%), and the lumbar force (-37.0%) and neck torque (-40.4%) were substantially lower.

Table 11. Summary of X-Axis Peak Acceleration Data at 10G (Cell J)

	JPATS-S		JPATS-L		ADAM-L	
Channel	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)
Sled X Accel (G)	10.13 ± 0.06	118.4 ± 3.85	10.07 ± 0.11	121.4 ± 4.04	10.09 ± 0.05	120.2 ± 3.49
Head X Accel (G)	15.15 ± 0.33	142.6 ± 3.58	14.67 ± 0.54	141.8 ± 8.20	13.94 ± 0.54	133.8 ± 5.27
Ext Chest X Accel (G)	11.33 ± 0.45	113.4 ± 22.9	11.68 ± 0.81	109.6 ± 9.63	12.62 ± 1.51	111.5 ± 18.17
Int Chest X Accel (G)	11.08 ± 0.44	129.8 ± 17.7	12.97 ± 0.84	122.6 ± 12.64	13.48 ± 0.25	128.2 ± 3.19
Pelvis X Accel (G)	11.66 ± 0.61	92.00 ± 14.5	17.12- ± 1.09	115.0 ± 12.41	15.04 ± 1.38	121.0 ± 7.40
Neck X Force (LBS)	144.2 ± 3.43	140.8 ± 3.49	221.1 ± 10.28	143.0 ± 8.15	154.7 ± 8.43	134.8 ± 6.27
Lumbar X Force (LBS)	131.6 (-) ± 14.7	85.40 ± 6.19	146.1 (-) ± 34.3	92.50 ± 15.8	184.0 (+) ± 9.91	153.2 ± 5.91
Neck MY Torque (IN-LBS)	31.36 (-) ± 7.22	117.3 ± 26.4	96.29 (+) ± 6.18	145.6 ± 13.4	210.0 (-) ± 7.81	131.2 ± 18.7
Lumbar MY Torque (IN-LBS)	540.1 (+) ± 59.0	86.60 ± 6.39	764.9 (+) ± 146	93.5 ± 16.4	520.5 (-) ± 53.3	139.0 ± 20.6

Table 12. Summary of X-Axis JPATS Peak Acceleration Data at 10-45G (Cells K-P)

	JPATS-S Peak Magnitude						JPATS-L Peak Magnitude		
Channel	10G	20G	30G	35G	40G	45G	10G	20G	30G
Sled X Accel (G)	9.82 ± 0.10	20.76 ± 0.05	30.15 ± 0.91	36.55 ± 0.88	42.28* ± 0.00	44.76* ± 0.00	10.09 ± 0.19	20.02 ± 0.16	29.10* ± 0.00
Head X Accel (G)	20.32 ± 1.26	46.98 ± 3.16	85.79 ± 4.29	–	–	–	19.93 ± 0.71	46.87 ± 2.38	–
Ext Chest X Accel (G)	12.61 ± 0.34	31.44 ± 0.54	66.68 ± 4.34	–	–	–	11.69 ± 1.31	32.72 ± 4.46	–
Int Chest X Accel (G)	15.39 ± 0.68	35.46 ± 1.01	53.20 ± 5.00	68.79 ± 3.31	81.74* ± 0.00	83.38* ± 0.00	15.85 ± 0.61	38.82 ± 2.25	65.82* ± 0.00
Pelvis X Accel (G)	9.55 ± 0.09	20.08 ± 1.03	31.76 ± 1.42	38.45 ± 5.46	47.97* ± 0.00	45.81* ± 0.00	12.18 ± 1.42	35.08 ± 2.36	51.66* ± 0.00
Neck X Force (LBS)	201.1 ± 8.61	281.3 ± 40.3	362.0 ± 21.9	–	–	–	298.4 ± 11.1	638.0 ± 19.8	–
Lumbar X Force (LBS)	123.9 ± 9.54	305.2 ± 54.8	499.9 ± 115	571.5* ± 0.00	819.4* ± 0.00	556.6* ± 0.00	100.2 ± 20.9	258.5 ± 42.8	317.2* ± 0.00
Neck MY Torque (-) (IN-LBS)	121.9 ± 21.60	265.6 ± 12.3	426.7 ± 83.4	–	–	–	159.4 ± 19.9	313.0 ± 87.2	–
Lumbar MY Torque (+) (IN-LBS)	692.0 ± 35.8	1263 ± 135	2155 ± 59.9	2292 ± 677	2700* ± 0.00	2525* ± 0.00	1216 ± 75.5	1490 ± 172	1655* ± 0.00

*Only one test available

Table 13. Summary of X-Axis ADAM Peak Acceleration Data at 10-45G (Cells K-O)

	ADAM-S Peak Magnitude				ADAM-L Peak Magnitude		
Channel	10G	20G	35G	45G	10G	20G	30G
Sled X Accel (G)	9.85 ± 0.05	21.20 ± 0.03	37.59 ± 0.28	46.36 ± 0.15	10.15 ± 0.08	20.06 ± 0.26	31.40 ± 0.61
Head X Accel (G)	19.71 ± 0.88	51.23 ± 5.69	89.14 ± 2.94	112.4 ± 3.87	18.44 ± 0.99	46.52 ± 2.03	68.99 ± 1.46
Ext Chest X Accel (G)	15.23 ± 2.94	26.83 ± 2.62	66.94 ± 13.8	102.1 ± 15.5	20.05 ± 3.13	22.44 ± 3.45	53.93 ± 3.30
Int Chest X Accel (G)	13.64 ± 0.36	29.15 ± 1.84	58.33 ± 1.74	77.68 ± 12.0	17.85 ± 2.24	39.52 ± 4.61	60.18 ± 4.29
Pelvis X Accel (G)	–	–	–	–	11.99 ± 0.58	29.22 ± 0.98	44.09 ± 5.89
Neck X Force (LBS)	211.9 ± 8.05	536.5 ± 67.6	948.9 ± 235	1052 ± 164	214.9 ± 13.9	541.5 ± 19.12	785.7 ± 30.70
Lumbar X Force (LBS)	196.6 ± 19.1	594.6 ± 22.2	904.7 ± 66.2	1169 ± 74.4	240.5 ± 18.9	543.7 ± 23.5	907.4 ± 80.0
Neck MY Torque (-) (IN-LBS)	204.5 ± 25.4	355.0 ± 34.2	516.1 ± 112	445.2* ± 0.00	322.3 ± 9.78	753.4 ± 41.4	675.2 ± 47.2
Lumbar MY Torque (+) (IN-LBS)	–	–	–	–	808.8 ± 44.1	1025 ± 49.1	1558 ± 215

*Only one test available

Table 14. Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10G (Cell J)

Channel	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude	% Difference
Head X Accel (G)	14.67	13.94	+5.2%
Int Chest X Accel (G)	12.97	13.48	NSD
Pelvis X Accel (G)	17.12	15.04	+13.8%
Neck X Force (LBS)	221.1	154.7	+42.9%
Lumbar X Force (LBS)	146.1 (-)	184.0 (+)	*
Neck MY Torque (IN-LBS)	96.29 (+)	210.0 (-)	*
Lumbar MY Torque (IN-LBS)	764.9	520.5	+47.0%

* Opposite Polarities

Table 15. Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 10G (Cell K)

Channel	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude	% Difference
Head X Accel (G)	19.93	18.44	+8.1%
Int Chest X Accel (G)	15.85	17.85	-11.2%
Pelvis X Accel (G)	12.18	11.99	NSD
Neck X Force (LBS)	298.4	214.9	+38.9%
Lumbar X Force (LBS)	100.2	240.5	-58.3%
Neck MY Torque (IN-LBS)	159.4	322.3	-50.5%
Lumbar MY Torque (IN-LBS)	1216	808.8	+50.3%

Table 16. Mann-Whitney U Tests of JPATS-S vs. ADAM-S at 10G (Cell K)

Channel	JPATS-S Peak Magnitude	ADAM-S Peak Magnitude	% Difference
Head X Accel (G)	20.32	19.71	NSD
Int Chest X Accel (G)	15.39	13.64	+12.8%
Neck X Force (LBS)	201.1	211.9	NSD
Lumbar X Force (LBS)	123.9	196.6	-37.0%
Neck MY Torque (IN-LBS)	121.9	204.5	-40.4%

Simulation of Human Response: Tables 17 and 18 give the results of Mann-Whitney U tests performed on the data in cell J which were used to compare the JPATS manikins' mean peak responses to data collected during human impact tests run under identical conditions. The Large JPATS head acceleration peak magnitude and time-to-peak were almost identical to the corresponding human male responses. However, external chest acceleration peak magnitude in the Large JPATS was lower (-27.4%) with a shorter time-to-peak response (-26.5%) than the human male data. In the Small JPATS, the head acceleration peak magnitude and time-to-peak were very close to the corresponding human female responses. The Small JPATS external chest acceleration peak magnitude was lower (-28.2%) and its time-to-peak was shorter (-24.0%) than the human female data. It should be noted that the Small JPATS vs. Human Female comparisons are not statistically significant due to the small sample size of the human female subjects.

Table 17. Mann-Whitney U Tests of JPATS-L vs. Human-M at 10G (Cell J)

Channel	JPATS-L Peak Magnitude	HUMAN-M Peak Magnitude	% Difference
Head X Accel (G)	14.67	15.08	NSD
Ext Chest X Accel (G)	11.68	16.09	-27.4%

Channel	JPATS-L Time-to-Peak	HUMAN-M Time-to-Peak	% Difference
Head X Accel (MS)	141.8	141.8	NSD
Ext Chest X Accel (MS)	109.6	149.1	-26.5%

Table 18. Comparison of JPATS-S vs. Human-F at 10G (Cell J)

Channel	JPATS-S Peak Magnitude	HUMAN-F Peak Magnitude	% Difference *
Head X Accel (G)	15.15	13.95	+8.6%
Ext Chest X Accel (G)	11.33	15.77	-28.2%

Channel	JPATS-S Time-to-Peak	HUMAN-F Time-to-Peak	% Difference *
Head X Accel (MS)	142.6	138.0	+3.3%
Ext Chest X Accel (MS)	113.4	149.3	-24.0%

* Human-F sample size too small for Mann-Whitney U tests

Repeatability: Repeatability data for manikin peak responses in the x-axis for cells K (10 G) and L (20 G) are given in Table 19. The Small JPATS demonstrated relatively consistent repeatability in the head, chest, and pelvis accelerations for both cells (all less than ± 13.5%), but showed poor repeatability for the neck force (± 28.7), lumbar force (± 35.9%), and lumbar torque (± 21.4%) in cell L , and neck torque in cell K (± 35.4%). The Large JPATS demonstrated consistent repeatability in the head acceleration, internal chest acceleration, and neck force for both cells (all less than ± 11%), but poor repeatability for pelvis acceleration (± 23.3%), lumbar force (± 41.7%), and neck torque (± 25.0) in cell K, and lumbar force (± 36.9%), neck torque (± 43.2%), and lumbar torque (± 23.6%) in cell L. The Small ADAM demonstrated consistent repeatability in the head acceleration, internal chest acceleration, and neck force (all less than ± 9%), but poor repeatability in the lumbar force (± 19.4%), neck torque (± 24.8%), and lumbar torque (± 52.1%). The Large ADAM demonstrated consistent repeatability in the head acceleration, pelvis acceleration, neck force, neck torque, and lumbar torque (all less than ± 13%), but poor repeatability in the internal chest acceleration (± 25.1%). (Small and Large ADAM repeatability measurements were for cell K only).

Table 19. Repeatability of Manikin Dynamic Response in X-Axis at 10-20G (Cells K,L)

	JPATS-S Peak Magnitude		JPATS-L Peak Magnitude		ADAM-S Peak Mag	ADAM-L Peak Mag
Channel	10 G	20 G	10 G	20 G	10 G	10 G
Sled X Accel (G)	± 2.0%	± 0.5%	± 3.8%	± 1.8%	± 1.0%	± 1.6%
Head X Accel (G)	± 12.4%	± 13.5%	± 7.1%	± 6.3%	± 8.9%	± 10.7%
Int Chest X Accel (G)	± 8.8%	± 5.7%	± 7.7%	± 11.0%	± 5.3%	± 25.1%
Pelvis X Accel (G)	± 1.9%	± 10.3%	± 23.3%	± 9.9%	–	± 9.7%
Neck X Force (LBS)	± 8.6%	± 28.7%	± 7.4%	± 6.9%	± 7.6%	± 12.9%
Lumbar X Force (LBS)	± 15.4%	± 35.9%	± 41.7%	± 36.9%	± 19.4%	± 15.7%
Neck MY Torque (IN-LBS)	± 35.4%	± 9.3%	± 25.0% *	± 43.2%	± 24.8%	± 6.1%
Lumbar MY Torque (IN-LBS)	± 10.3%	± 21.4%	± 12.4%	23.6%	± 52.1%	± 10.9%

* Only three tests available

Acceleration Plots: Response plots of the manikins' mean peak magnitudes in x-axis tests for increasing sled acceleration levels of 10-45 G are shown in Figures 12-18. Head and internal chest accelerations increased linearly with sled acceleration for all four manikins and were fairly close in magnitude except the Small ADAM chest acceleration, which was slightly lower than in the other manikins. Linear increases were also observed in the three manikins (no Small ADAM data was available) for the pelvis accelerations. However, this measurement was substantially lower in the Small JPATS than in the other two manikins, and actually decreased at 45 G. Neck forces increased fairly linearly with increasing acceleration in all four manikins, but the force as well as the rate of increase was substantially lower in the Small JPATS manikin compared to the other three. The lumbar forces were much lower at all acceleration levels in the two JPATS manikins compared to the two ADAM manikins. In addition, the rate of increase in the Large JPATS for this measurement was non-linear and in fact showed almost no increase from 20 to 30 G. The Small JPATS also behaved non-linearly for this measurement at 40-45 G. The neck torque increased linearly up to 35 G for all manikins except the Large ADAM, where it increased steeply from 10 to 20 G, and then decreased from 20 to 30 G. The lumbar torque increased very little in the Large JPATS, while increasing somewhat non-linearly in the Small JPATS and in the Large ADAM.

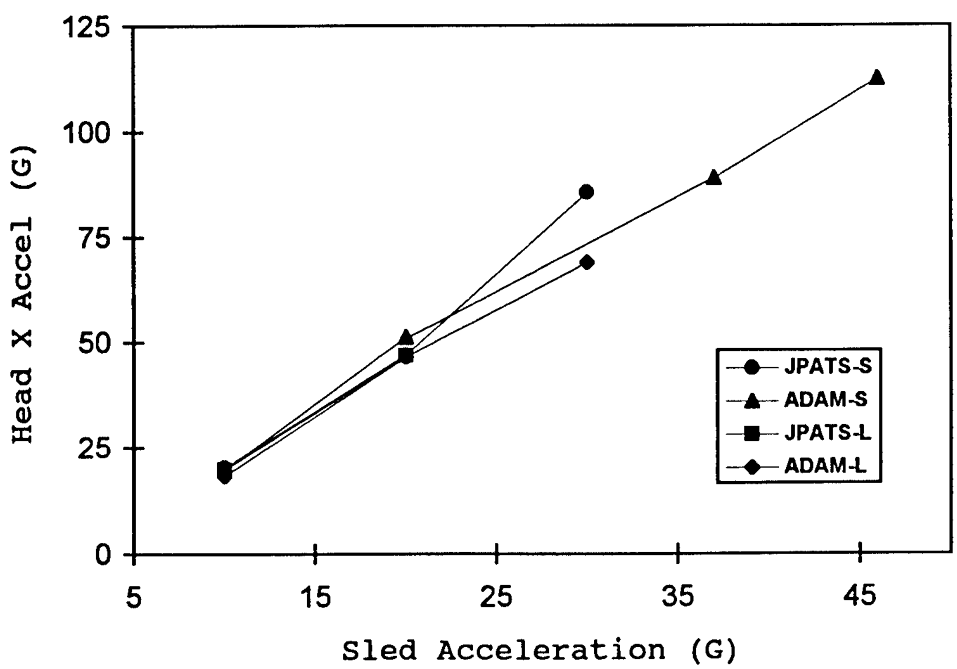


Fig 12. Head X Acceleration vs. Sled Acceleration

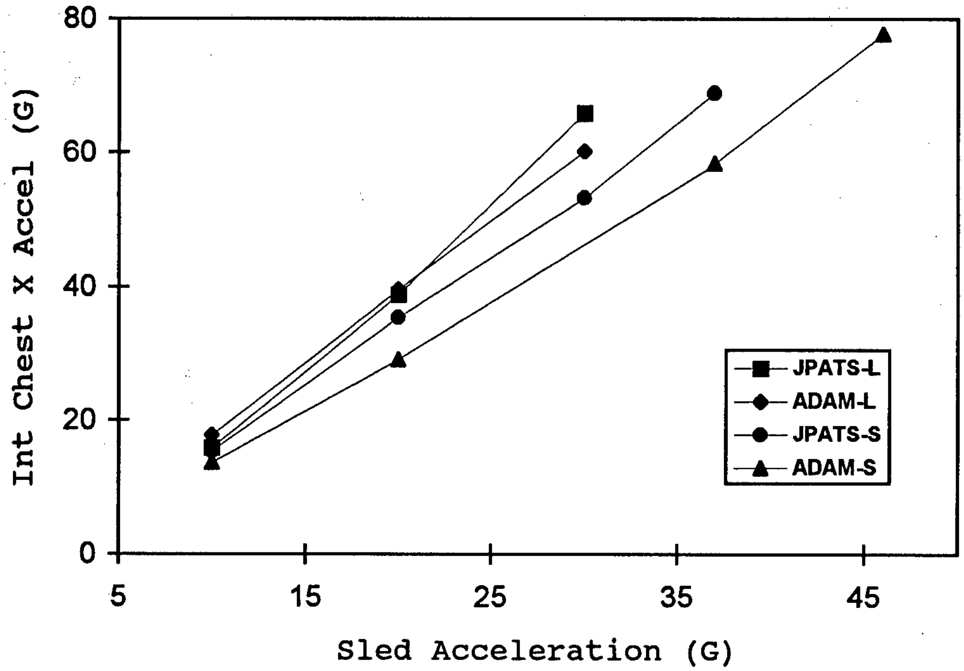


Fig 13. Internal Chest X Acceleration vs. Sled Acceleration

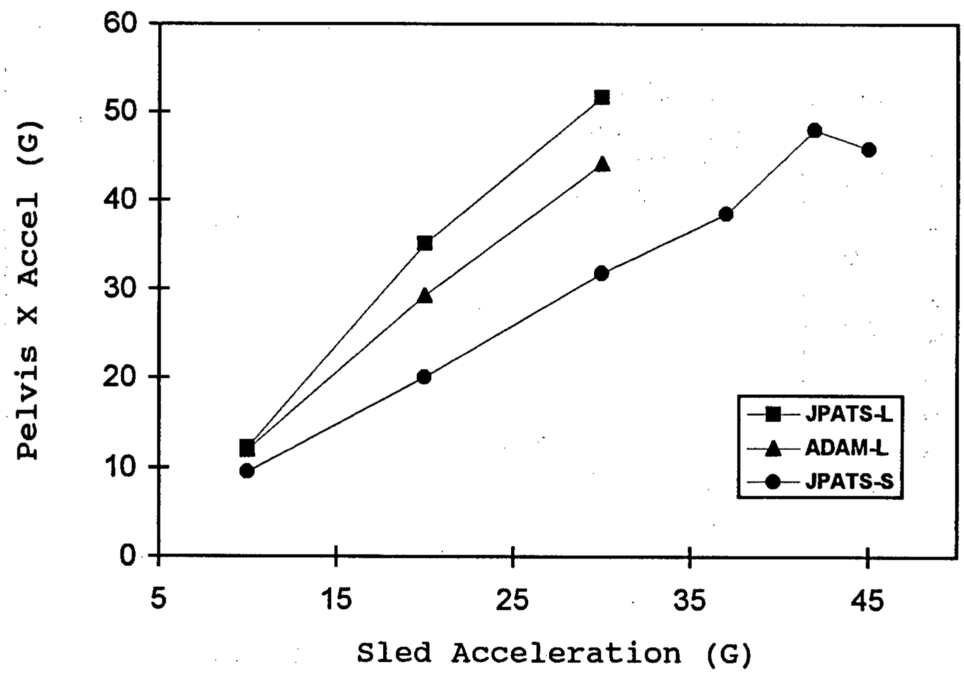


Fig 14. Pelvis X Acceleration vs. Sled Acceleration

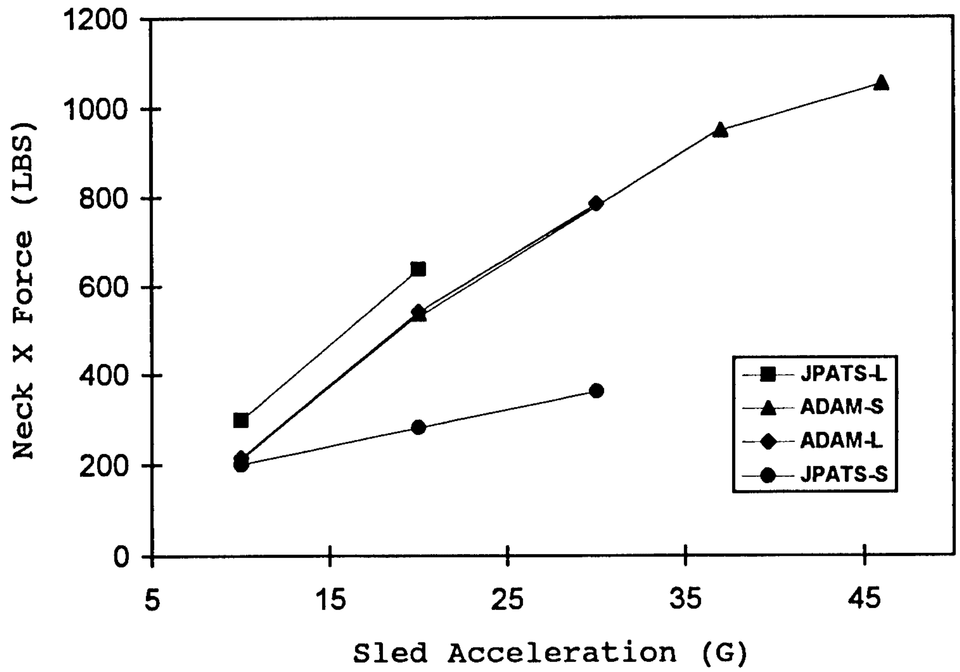


Fig 15. Neck X Force vs. Sled Acceleration

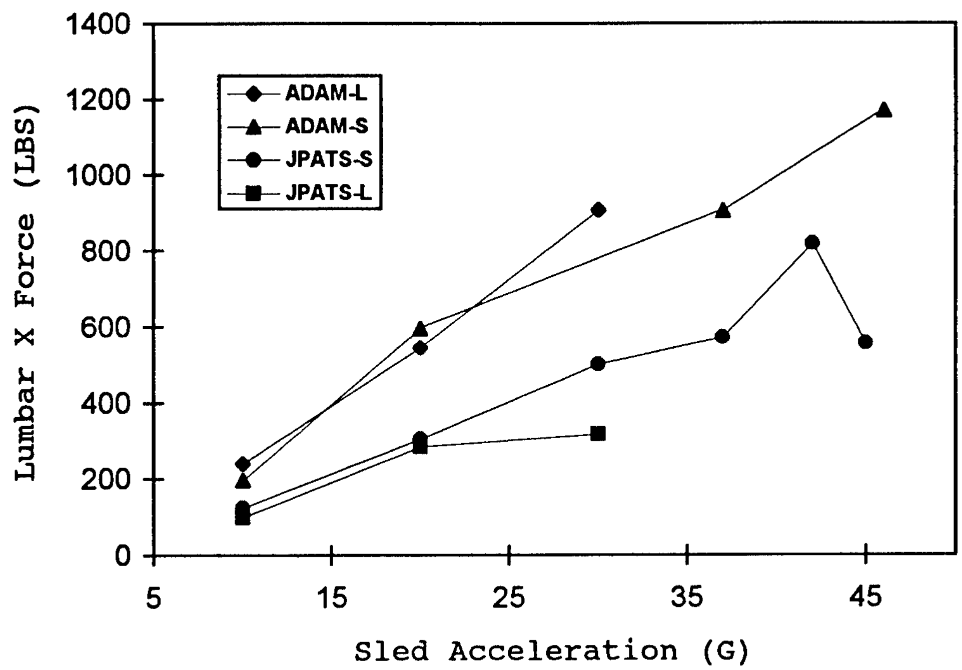


Fig 16. Lumbar X Force vs. Sled Acceleration

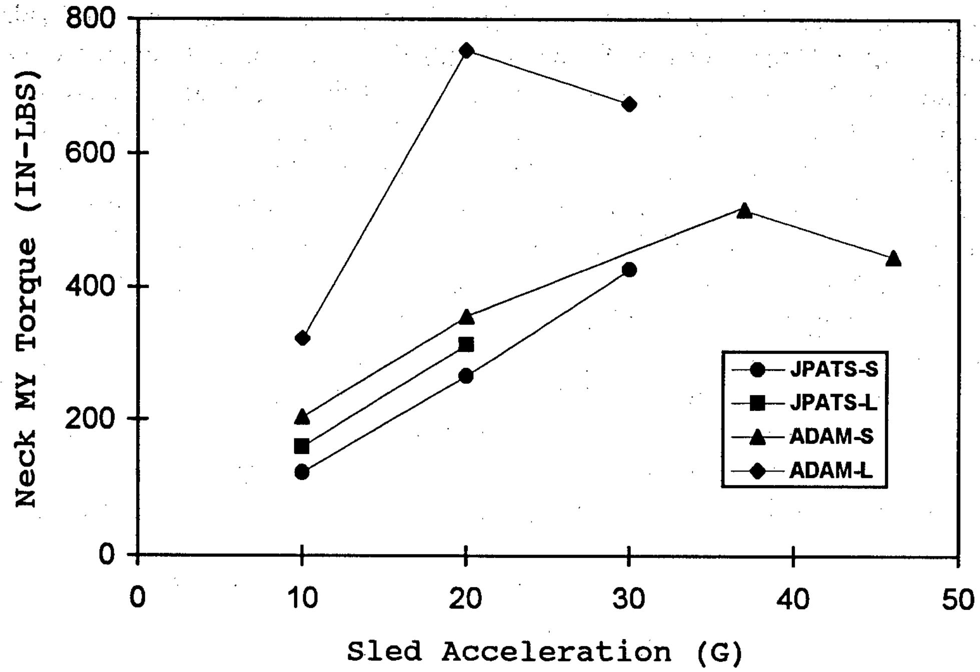


Fig 17. Neck MY Torque (-) vs. Sled Acceleration

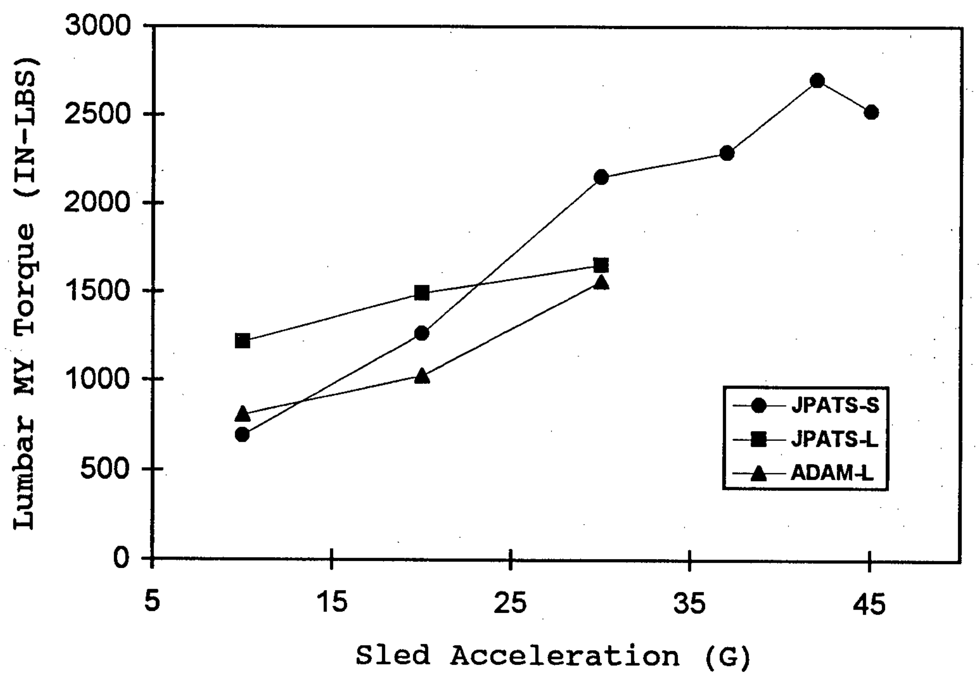


Fig 18. Lumbar MY Torque (+) vs. Sled Acceleration

Y-Axis

Manikin Comparisons: Complete y-axis biodynamic response data are given in Tables 20 and 21. Mann-Whitney U tests were performed on cells F and H in order to compare the mean peak magnitudes of the manikin responses at 7 and 10 G sled acceleration levels, with the results shown in Tables 22-24. In the 7 G tests (Cell F), all Large JPATS measurements were within 6% of the Large ADAM values, with the exception of the head acceleration (-16.5%), lumbar force (+32.2%), and lumbar torque (+97.6%). In the 10 G tests (cell H), the Large JPATS head acceleration (-13.8%), internal chest acceleration (-16.9%), pelvis acceleration (-22.3%), and lumbar force (-83.9%) were all lower than in the Large ADAM, while the neck force was slightly larger (+9.5%). There were no significant differences between the two manikins' neck torques or lumbar torques. In the Small JPATS (Cell H), the head acceleration was almost identical to the Small ADAM measurement, while the neck force (-27.8%), lumbar force (-89.1%), and neck torque (-53.6%) were all substantially lower, and the internal chest acceleration was higher (+23.8%). (Statistical significance can not be inferred in the Small JPATS vs Small ADAM comparisons due to the small number of Small ADAM tests).

Table 20. Summary of Y-Axis Peak Acceleration Data at 7G (Cell F)

	JPATS-S		JPATS-L		ADAM-L	
Channel	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)	Peak Magnitude	Time-to-Peak (ms)
Sled X Accel (G)	7.04 ± 0.05	75.3 ± 3.21	7.06 ± 0.05	74.0* ± 0.0	7.08 ± .08	–
Head Y Accel (G)	12.34 ± 0.97	159.7 ± 3.88	16.54 ± 0.77	156.8 ± 6.05	19.82 ± 0.72	137.8 ± 8.32
Ext Chest Y Accel (G)	16.78 ± 0.83	114.7 ± 3.51	16.86* ± 0.0	136.0* ± 0.0	–	–
Int Chest Y Accel (G)	15.26 ± 1.12	107.6 ± 4.1	17.42 ± 0.35	124.8 ± 5.64	18.52 ± 0.56	120.8 ± 8.35
Pelvis Y Accel (G)	10.22 ± 0.74	96.2 ± 5.19	15.08 ± 0.71	94.8 ± 6.88	14.72 ± 1.94	112.0 ± 13.7
Neck Y Force (LBS)	112.0 ± 9.93	155.2 ± 3.19	182.3 ± 3.06	147.3 ± 9.35	190.0 ± 5.62	144.6 ± 6.73
Lumbar Y Force (LBS)	202.4 ± 8.83	100.0 ± 5.66	368.7 ± 16.3	114.2 ± 6.05	278.9 ± 49.9	104.6 ± 13.4
Neck MX Torque (+) (IN-LBS)	67.13 ± 12.5	162.3 ± 20.6	536.9 ± 28.2	161.8 ± 6.08	516.9 ± 27.1	148.2 ± 5.97
Lumbar MX Torque (+) (IN-LBS)	940.1 ± 47.0	99.5 ± 5.47	2087 ± 102	115.7 ± 5.35	1056 ± 207	114.2 ± 13.7

* Only one test available

Table 21. Summary of Y-Axis Peak Acceleration Data at 10-14G (Cells H,I)

	JPATS-S Peak Magnitude		JPATS-L Peak Magnitude		ADAM-S Peak Magnitude		ADAM-L Peak Magnitude	
Channel	10 G	14 G	10 G	14 G	10 G	14 G	10 G	14 G
Sled X Accel (G)	10.08 ± 0.25	14.11 ± 0.05	10.25 ± 0.15	14.18 ± 0.29	9.99 ± 0.11	14.59 ± 0.12	10.18 ± 0.08	14.04 ± 0.04
Head Y Accel (G)	13.33 ± 0.85	16.17 ± 1.35	16.32 ± 0.44	20.26 ± 1.83	13.00 ± 0.70	17.90 ± 0.94	18.93 ± 0.62	24.20 ± 0.83
Ext Chest Y Accel (G)	20.17 ± 0.88	31.55 ± 1.91	11.75 ± 0.41	19.58 ± 1.73	24.40 ± 6.55	35.19 ± 16.0	23.86 ± 1.72	31.60 ± 2.37
Int Chest Y Accel (G)	20.78 ± 1.03	25.92 ± 1.67	13.43 ± 0.53	17.92 ± 1.23	16.79 ± 3.54	24.77 ± 7.78	16.16 ± 1.96	24.80 ± 1.25
Pelvis Y Accel (G)	21.82 ± 1.96	35.14 ± 1.15	21.07 ± 0.65	29.44 ± 2.61	–	–	27.13 ± 1.17	35.67 ± 0.40
Neck Y Force (LBS)	92.72 ± 11.3	104.6 ± 9.91	215.2 ± 10.4	278.4 ± 16.4	128.4 ± 9.37	165.4 ± 12.2	196.5 ± 7.75	242.0 ± 4.86
Lumbar Y Force (LBS)	36.61 ± 4.89	66.71 ± 10.5	220.9 ± 27.9	381.3 ± 87.7	336.2 ± 43.0	635.0 ± 29.4	120.1 ± 19.8	130.2 ± 6.61
Neck MX Torque (+) (IN-LBS)	67.47 ± 15.8	112.7 ± 20.6	351.3 ± 77.3	368.7 ± 47.7	145.3 ± 21.8	214.2 ± 43.4	412.6 ± 30.4	503.0 ± 17.8
Lumbar MX Torque (+) (IN-LBS)	226.0 ± 25.5	342.0 ± 62.1	1151 ± 167	1960 ± 418	–	–	1313 ± 203	1519 ± 211

Table 22. Mann-Whitney U Tests of JPATS-L vs. ADAM-L at 7G (Cell F)

Channel	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude	% Difference
Head Y Accel (G)	16.54	19.82	-16.5%
Int Chest Y Accel (G)	17.42	18.52	-5.9%
Pelvis Y Accel (G)	15.08	14.72	NSD
Neck Y Force (LBS)	182.3	190.0	-4.1%
Lumbar Y Force (LBS)	368.7	278.9	+32.2%
Neck MX Torque (IN-LBS)	536.9	516.9	NSD
Lumbar MX Torque (IN-LBS)	2087	1056	+97.6%

Table 23. Mann-Whitney U Tests Of JPATS-L vs. ADAM-L at 10G (Cell H)

Channel	JPATS-L Peak Magnitude	ADAM-L Peak Magnitude	% Difference
Head Y Accel (G)	16.32	18.93	-13.8%
Int Chest Y Accel (G)	13.43	16.16	-16.9%
Pelvis Y Accel (G)	21.07	27.13	-22.3%
Neck Y Force (LBS)	215.2	196.5	+9.5%
Lumbar Y Force (LBS)	220.9	120.1	-83.9%
Neck MX Torque (IN-LBS)	351.3	412.6	NSD
Lumbar MX Torque (IN-LBS)	1151	1313	NSD

Table 24. Comparison of JPATS-S vs. ADAM-S at 10G (Cell H)

Channel	JPATS-S Peak Magnitude	ADAM-S Peak Magnitude	% Difference *
Head Y Accel (G)	13.33	13.00	+2.5%
Int Chest Y Accel (G)	20.78	16.79	+23.8%
Pelvis Y Accel (G)	21.82	---	---
Neck Y Force (LBS)	92.72	128.4	-27.8%
Lumbar Y Force (LBS)	36.61	336.2	-89.1%
Neck MX Torque (IN-LBS)	67.47	145.3	-53.6%

* Sample size of ADAM-S too small for Mann-Whitney U tests

Simulation of Human Response: Table 25 gives the results of Mann-Whitney U tests performed on the 7 G (cell F) data, which were used to compare the Large JPATS mean peak responses to data taken from human male impact tests previously run under identical conditions (no human female data was available). The Large JPATS peak magnitude head acceleration (+13.7%) and external chest acceleration (+27.8%) were both larger, and the time-to-peak responses of these two measurements were both slightly longer (+17.5% and +12.1%) than the corresponding human male responses. However, statistical significance can not be inferred from the external chest comparisons due to the availability of only one data point for the JPATS tests.

Table 25. Mann-Whitney U Tests of JPATS-L vs. Human-M at 7G (Cell F)

Channel	JPATS-L Peak Magnitude	HUMAN-M Peak Magnitude	% Difference
Head Y Accel (G)	16.54	14.55	+13.7%
Ext Chest Y Accel (G)	16.86	13.19	+27.8% *

Channel	JPATS-L Time-to-Peak	HUMAN-M Time-to-Peak	% Difference
Head Y Accel (MS)	156.8	133.5	+17.5%
Ext Chest Y Accel (MS)	136.0	121.3	+12.1% *

* No statistical significance due to only one JPATS-L test

Repeatability: Repeatability data for manikin peak responses in the y-axis for 7 and 10 G tests (cells F and H) are given in Table 26. The Small JPATS demonstrated repeatability in the ± 10-20% range on all channels except the neck torque (± 38.5%) in Cell F, and the neck force (± 24.4%), lumbar force (± 26.7%), neck torque (± 46.8%), and lumbar torque (± 22.6%) in Cell H. Only the Small JPATS repeatability in the lumbar force (± 8.2%) in Cell F and internal chest acceleration (± 9.9%) in Cell H were less than ± 10%. The Large JPATS demonstrated repeatability below ± 11% on all channels except the lumbar force (± 25.3%), neck torque (± 44.0%), and lumbar torque (± 29.0%) in Cell H. The Large ADAM demonstrated repeatability under ± 14% for all channels except the pelvis acceleration (± 26.4%), lumbar force (± 35.8%), and lumbar torque (± 39.2%) in Cell F, and lumbar torque (± 19.3%) in Cell H.

Table 26. Repeatability of Manikin Dynamic Response in Y-Axis at 7-10 G (Cells F,H)

	JPATS-S Peak Magnitude		JPATS-L Peak Magnitude		ADAM-L Peak Magnitude	
Channel	7 G	10 G	7 G	10 G	7 G	10 G
Sled X Accel (G)	± 1.7%	± 5.0%	± 1.4%	± 2.9%	± 2.3%	± 1.4%
Head Y Accel (G)	± 17.1%	± 12.8%	± 9.0%	± 5.4%	± 7.3%	± 4.1%
Int Chest Y Accel (G)	± 14.7%	± 9.9%	± 4.4%	± 7.9%	± 6.0%	± 10.6%
Pelvis Y Accel (G)	± 11.3%	± 18.0%	± 9.9%	± 6.2%	± 26.4%	± 7.4%
Neck Y Force (LBS)	± 18.0%	± 24.4%	± 3.6%	± 9.7%	± 5.9%	± 4.4%
Lumbar Y Force (LBS)	± 8.2%	± 26.7%	± 9.4%	± 25.3%	± 35.8%	± 13.6%
Neck MX Torque (IN-LBS)	± 38.5%	± 46.8%	± 7.7%	± 44.0%	± 10.5%	± 12.4%
Lumbar MX Torque (IN-LBS)	± 11.2%	± 22.6% *	± 10.9%	± 29.0%	± 39.2%	± 19.3%

* Only four tests available

DISCUSSION

Structural Integrity

Both JPATS manikins were able to structurally withstand peak acceleration levels up to and including +24 Gz, -20 Gx, and +14 Gy. At and above -30 Gx, serious weaknesses were exposed in the neck bracket, which provided support and stability for the head. This structure had an inherent design deficiency in the tendency of the neck bolt to experience the full force of the head acceleration and pull out of its insert (Figure 19). The greater the sled acceleration the higher the head acceleration amplification, resulting in peak head accelerations as high as 85 G during a 30 G sled run. The bracket should be reinforced or redesigned, taking into account this amplification factor of head acceleration during high-G impact tests. Broken knee stops also occurred at acceleration levels at and above -20 Gx of sled acceleration in the Large JPATS only. To correct this problem, sturdier stops need to be fitted in the knee joints.

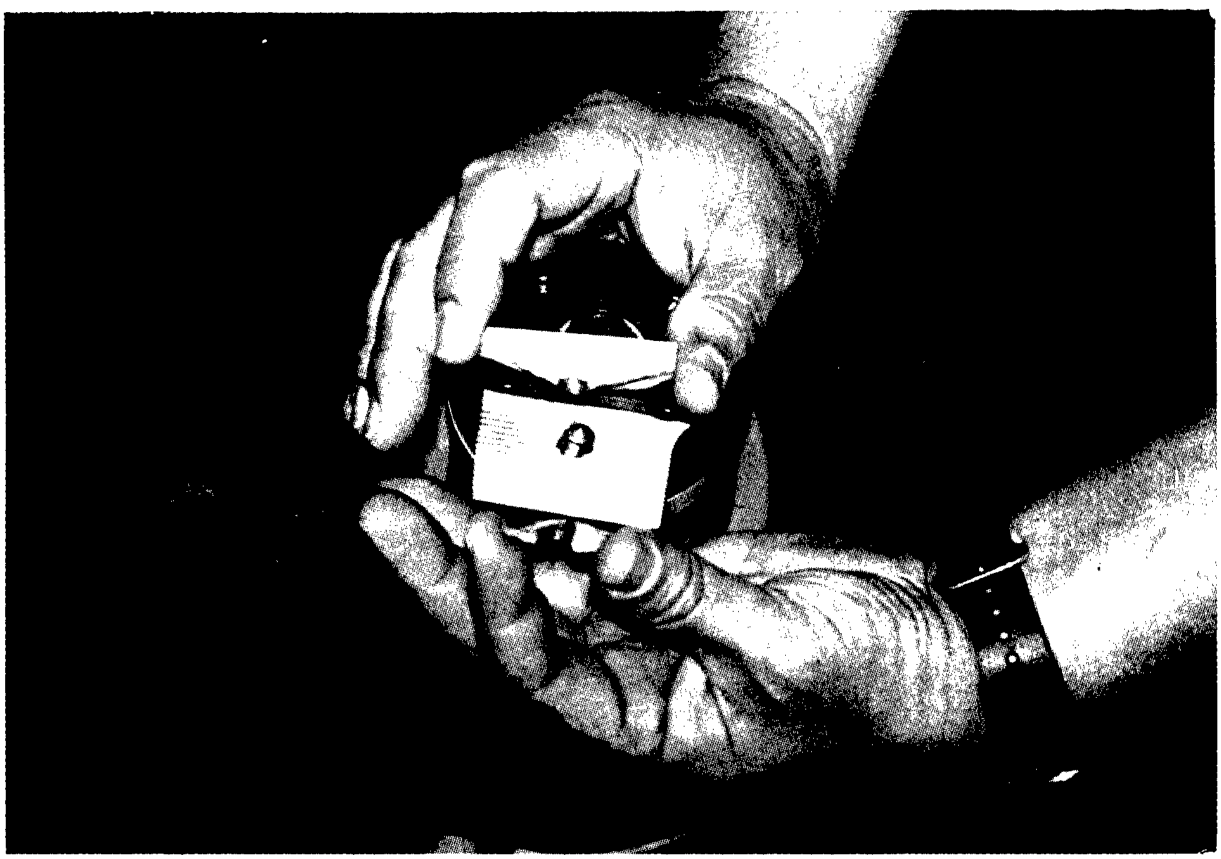


Figure 19. Broken Neck Bracket in Large JPATS Manikin

Instrumentation System

The most frequently encountered problem in the JPATS instrumentation system was improper triggering of the Data Acquisition System (DAS). The DAS receives a pulse just prior to the start of impact which normally causes it to begin collecting data. In nine instances during the test program, the DAS was either triggered prematurely before it received the pulse or did not trigger properly upon receiving the pulse. Another frequently encountered problem with the DAS was event marker misplacement. The DAS would generate improper instructions which caused the marker to be improperly inserted in the data. In some cases this had the effect of instructing all channels to change the sample rate, resulting in corrupted data files. Fortunately, the data was able to be recovered in these instances by correct reinsertion of the marker. There were also two instances of the DAS stopping data collection at impact and another where the DAS continued to collect data after impact. In one of the no-data collection events, the cause was determined to be the power line to the internal DAS which was broken during impact. There were also seven instances of bad data on individual channels, all in the Small JPATS. These are typically caused by loose or broken wires or connectors between the transducers and the DAS. There was also one instance in a Large ADAM test where a large spike was observed on most of the data channels.

The DAS battery system appeared to be structurally stable during impact, and when fully charged resulted in satisfactory collection and temporary storage of the data. However, it did not always retain its full charge over extended periods of time and in several instances no data was collected due to low voltage. We would recommend either a longer life battery system or more information on the expected battery discharge time as related to the use of the DAS.

Anthropometry

The extreme size of the JPATS manikins resulted in restraint problems in some cells during preparation for impact tests. In VDT tests, preloading the shoulder and lap belt tensions to the standard 20 ± 5 lbs resulted in a pronounced forward and lateral slump of the Large JPATS upper torso. This was due to the large mass of the torso having a center of gravity slightly forward of the manikin center. Increasing the tension to 25 ± 5 lbs provided sufficient pre-test stability. In HIA tests in Cell J, the 20 ± 5 lbs tensions could not be obtained in the Small JPATS due to the small shoulder size of the manikin. The tests were conducted with 15 ± 5 lbs preloads which provided adequate stability. It might also be added that the angle of the shoulder harness attachment point in the Small JPATS was very close to the currently accepted maximum upper limit of 25°. This is similar to the harness angle seen in laboratory tests with small female subjects and has been identified as a causative factor in high spinal injury rates in some ejection seats (2,3,4).

Biodynamic Response

<u>Comparison of JPATS and ADAM</u>

Z and X Axes: In general there were no large differences between the Large JPATS and Large ADAM or between the Small JPATS and Small ADAM manikins in the peak magnitudes of

the head, chest, and pelvis acceleration responses in the z and x axes, with most JPATS responses within 15% of the corresponding ADAM measurements. An exception was the pelvis acceleration for three of the manikins (no Small ADAM data was available) at higher acceleration levels in the x-axis, which appeared to be influenced by the manikins' weight or mass. In addition, there were some noticeable differences in neck responses between the manikins. The neck force peak magnitudes generated by the Small JPATS in both the z and x axes measured substantially lower than in the other three manikins. The relatively small difference in head weight alone could not account for these large differences. The overall z-axis neck torque profile was somewhat similar in the three manikins in cell A (no Small ADAM data was available). However, the manikins had different peak magnitudes, with the Small JPATS generating a greater initial positive swing and smaller secondary negative swing, while both the Large JPATS and Large ADAM generated smaller initial positive swings and larger secondary negative swings. In cells B-E, the Small ADAM also differed sharply from both JPATS manikins in the neck torque response profile and appeared to be abnormally low in neck torque peak magnitude compared to the JPATS manikins. In the x-axis, the Small and Large JPATS neck torque profiles were somewhat similar between the manikins while varying in their negative and positive peak magnitudes. The same was true for the Small and Large ADAM manikins. The ADAM torque profiles and peak magnitudes, however, were generally quite different from the JPATS responses, demonstrating that there is a significant difference in neck stiffness or in the head mounting between the two sets of manikins.

Lumbar force and lumbar torque measurements appeared normal in the z-axis for all manikins with the exception of the Small ADAM lumbar force data, which was extremely low compared to the other three manikins. Even the lighter Small JPATS generated several times more lumbar force than the Small ADAM, probably due to its more flexible lumbar section. In the x-axis tests with 0° seat angle (cell J), both of these lumbar measurements were opposite in polarity between the JPATS and ADAM manikins, making direct comparisons difficult. In the remaining x-axis cells (30° seat angle, cells K-P), the Large JPATS generated lower than expected lumbar forces considering the large mass of the torso as compared to the other manikins. The general profiles of the lumbar force and torque plots in these same cells were somewhat similar between the ADAM and JPATS manikins, but the JPATS manikins had a greater tendency to generate both negative and positive swings in both measurements than the ADAM manikins. These response differences again made direct comparison of the manikin peak measurements difficult. The differences could be due to differences in lumbar stiffness or positioning of the lumbar load cell. It is also possible that the differences are due to varying upper versus lower torso motion due to differences in anthropometry, since the lumbar load cell is positioned close to where the upper and lower torso are connected. In some cells, the lower torso may have a greater tendency to slide out of the seat ahead of the upper torso. This would help explain the large differences in polarity of the lumbar force and torque between the JPATS and ADAM manikins in tests with 0° seat angle, since this occurrence would be less likely with a 30° inclined seat, as was the case.

Y Axis: The response profiles (acceleration, force, torque) in the head, neck, chest, pelvis, and lumbar areas in both the 7 and 10 G tests were similar among both JPATS manikins and the Large ADAM, with some moderate differences in the peak magnitudes. The lumbar response

profiles were also similar in these three manikins (no Small ADAM data was available) in the 7 G tests, with the peak magnitude increasing with the manikins' weight. Pronounced differences in peak magnitudes were present between the Small JPATS and Small ADAM manikin responses at 10 G in the chest, neck, and lumbar regions. Of particular concern is the low level of neck force in the Small JPATS compared to the other manikins, since the manikin heads are not substantially different in weight. In both the 10 and 14 G tests, the Large JPATS and Small ADAM generated only positive-going lumbar force and lumbar torque peak magnitudes, while the Small JPATS and Large ADAM generated small positive and large negative-going peak magnitudes. It is apparent that at higher acceleration levels (10 and 14 G) using a contoured seat with a slightly more inclined seat pan, the lumbar region of two of the manikins was reacting completely differently than the other two, making direct manikin comparisons difficult. Since the lumbar responses were similar for all manikins during the 7 G tests, it is unlikely that the lumbar load cell was improperly positioned. The more likely explanation, as described above, would be differences in the degree of upper versus lower torso motion due to differences in anthropometry. The designers may want to consider repositioning the lumbar load cell or shifting the lumbar center of mass for more consistent lumbar force and torque measurements among the manikins.

Repeatability of Response

In the z-axis, repeatability for the Small JPATS manikin was less consistent than either the Large JPATS or the Large ADAM, although all three performed well on most channels. The exceptions were poor neck torque repeatability in the Small JPATS and poor lumbar torque repeatability in both JPATS manikins. Repeatability in the x-axis was inconsistent for all four manikins, with unexpectedly poor repeatability in the Small JPATS neck force, Large JPATS pelvis acceleration, and Large ADAM internal chest acceleration. Also, none of the manikins' performance was fully satisfactory in the neck torque, lumbar torque, or lumbar force channels in this axis. In the y-axis tests, the Small JPATS again demonstrated the least consistent repeatability. All three manikins again demonstrated poor repeatability in the lumbar force and lumbar torque channels, and both JPATS again performed poorly in the neck torque channel. The Small JPATS neck force and Large ADAM pelvis acceleration channels also performed poorly in this axis.

In summary: 1) The Small JPATS was the least consistent manikin in terms of repeatability. 2) The neck torque and lumbar torque peak responses were not very repeatable for any of the manikins in any of the three axes (the only exception was the Large ADAM neck torque). Also, the lumbar force was not very repeatable for the x and y axes tests. Possible reasons for this were described in the previous section. 3) For most other channels, the z-axis measurements were the most consistent in all the manikins (± 1-12%), while the x and y channels in general had higher repeatabilities (± 5-25%).

Simulation of Human Response

In z-axis tests, the Large and Small JPATS manikins simulated human male and female head and chest acceleration responses reasonably well, although the Small JPATS chest acceleration peak magnitude was slightly larger than the corresponding female data. Peak seat forces generated in z-axis tests by the Small JPATS and Small ADAM were nearly identical to the

seat forces predicted by the human data regression line, while the Large JPATS and Large ADAM seat forces were slightly larger than the corresponding human data. However, the heaviest human subject weighed only 210 lbs which was less than either large manikin, so it is possible that the human seat forces at those levels may be closer to the manikin measurements than was predicted by the extrapolated data. In x-axis tests, both Small and Large JPATS manikins performed well in simulation of human head acceleration but both generated lower than expected peak magnitudes in the chest acceleration. Also, chest acceleration time-to-peak measurements were shorter in duration than expected. In y-axis tests, the Large JPATS generated larger than expected head and chest acceleration peak magnitudes and longer than expected time-to-peak responses than predicted by the human male data. The x and y axes manikin acceleration responses are a serious concern since they are sometimes used to generate human injury probabilities.

CONCLUSIONS

1) Both JPATS manikins were able to structurally withstand peak acceleration levels up to and including 24 G in the +z axis, 20 G in the -x axis, and 14 G in the +y axis. At and above 30 G in the -x axis, serious weaknesses were exposed in the neck bracket. The knee stops were also inadequate at 20 G in this same axis.

2) The lumbar response to z-axis impact of the Small JPATS demonstrated substantial improvement over the Small ADAM, possibly due to its more flexible lower torso.

3) The peak magnitude of the neck force generated by the Small JPATS was substantially lower in all axes than in the other three manikins. The relatively small difference in head weight alone could not account for this large difference.

4) The JPATS neck torque responses in the x-axis were generally quite different from the ADAM responses, possibly indicating a significant difference in neck stiffness between the two sets of manikins.

5) Neck torque measurements in all axes and lumbar force and lumbar torque in the x and y axes varied greatly among the manikins and showed poor repeatability in all axes. This made comparison of the manikin responses very difficult, although it was apparent that the Large JPATS generated lower than expected x-axis lumbar forces.

6) The Small JPATS demonstrated the least consistent repeatability of the four manikins.

7) Both JPATS manikins simulated human head and chest accelerations and seat forces well in the z-axis but there were some differences from the human data in the head and chest accelerations in the x and y axes.

8) The DAS performed adequately for most tests, but there were several instances of premature triggering and misplacement of event markers.

9) The battery system often did not retain its charge over extended periods of time. If testing is to last longer than 2-3 hours, either a longer life battery system needs to be incorporated or more information on the expected battery discharge time should be provided.

REFERENCES

1. Bartol A.M., Hazen V.L., Kowalski J.F., Murphy B.P., and White R.P. Jr. Advanced Dynamic Anthropomorphic Manikin (ADAM) Final Design Report, AAMRL-TR-90-023, 1990.

2. Brinkley J.W., Raddin J.H. Jr., and Powers J.M. Investigation of the Effects of Restraint Design Variations on Human Responses to Impact, Preprints of 1979 AsMA Annual Scientific Meeting, Washington D.C.

3. Kazarian L.E. F/FB-111 Escape Injury Mechanism Assessment, AMRL Technical Report 77-60, October 1977.

4. US Army. Crash Survival Design Guide, USAAMRDL Technical Report 71-22, October 1971.

APPENDIX A

TEST CONFIGURATION AND DATA ACQUISITION SYSTEM

TEST CONFIGURATION AND

DATA ACQUISITION SYSTEM FOR THE

IMPACT TESTING OF THE JPATS MANIKINS

DURING -Gx, +Gy and +Gz IMPACT ACCELERATIONS

(JPATS STUDY)

TEST PROGRAM

Prepared under
Contract F33601-96-DJ001

March 1996

Prepared by
Marshall Z. Miller
and
Stephen E. Mosher

DynCorp
Enterprise Management
Armstrong Laboratory Division
Building 824, Area B
Wright-Patterson AFB, Ohio 45433

TABLE OF CONTENTS

PAGE

INTRODUCTION....................A-6

1. TEST SYSTEMS....................A-6
   1.1 VERTICAL DECELERATION TOWER....................A-6
   1.2 HORIZONTAL IMPULSE ACCELERATOR....................A-6
2. SEAT FIXTURES....................A-7
   2.1 VIP SEAT FIXTURE....................A-7
   2.2 40 G SEAT FIXTURES....................A-7
      2.2.1 +Gy SEAT FIXTURE CONFIGURATIONS....................A-8
      2.2.2 -Gx SEAT FIXTURE CONFIGURATIONS....................A-8
3. TEST SUBJECTS....................A-8
4. TEST CONFIGURATIONS....................A-9
5. INSTRUMENTATION....................A-9
   5.1 ACCELEROMETERS....................A-10
      5.1.1 +Gz TEST CONFIGURATION....................A-10
      5.1.2 +Gy AND -Gx TEST CONFIGURATIONS....................A-11
      5.1.3 MANIKIN ACCELEROMETERS....................A-11
         5.1.3.1 JPATS MANIKIN ACCELEROMETERS....................A-11
         5.1.3.2 LARGE ADAM MANIKIN ACCELEROMETERS....................A-11
   5.2 LOAD TRANSDUCERS....................A-12
      5.2.1 +Gz TEST CONFIGURATION....................A-12
      5.2.2 +Gy AND -Gx TEST CONFIGURATIONS....................A-12
      5.2.3 MANIKIN LOAD TRANSDUCERS....................A-13
   5.3 CALIBRATION....................A-13
6. DATA ACQUISITION....................A-14
   6.1 AUTOMATIC DATA ACQUISITION AND CONTROL SYSTEM (ADACS)....A-14
   6.2 EME DAS-64 DATA ACQUISITION AND STORAGE SYSTEM....................A-15
   6.3 MANIKIN INTERNAL DATA ACQUISITION SYSTEM....................A-16
   6.4 SELSPOT MOTION ANALYSIS SYSTEM....................A-16
7. PROCESSING PROGRAMS....................A-17
   7.1 PROCESSING PROGRAMS - VERTICAL DECELERATION TOWER....................A-17
   7.2 PROCESSING PROGRAMS - HORIZONTAL IMPULSE ACCELERATOR.....A-18

LIST OF TABLES

TABLE **PAGE**

A-1. TEST CELL MATRIX....A-20
A-2. +Gz TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS
A-2a. PAGE 1 OF 3....A-21
A-2b. PAGE 2 OF 3....A-22
A-2c. PAGE 3 OF 3....A-23
A-3. +Gy AND -Gx TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS
A-3a. PAGE 1 OF 4....A-24
A-3b. PAGE 2 OF 4....A-25
A-3c. PAGE 3 OF 4....A-26
A-3d. PAGE 4 OF 4....A-27
A-4. SMALL JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS
A-4a. PAGE 1 OF 3....A-28
A-4b. PAGE 2 OF 3....A-29
A-4c. PAGE 3 OF 3....A-30
A-5. LARGE JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS
A-5a. PAGE 1 OF 3....A-31
A-5b. PAGE 2 OF 3....A-32
A-5c. PAGE 3 OF 3....A-33
A-6. LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS
A-6a. PAGE 1 OF 7....A-34
A-6b. PAGE 2 OF 7....A-35
A-6c. PAGE 3 OF 7....A-36
A-6d. PAGE 4 OF 7....A-37
A-6e. PAGE 5 OF 7....A-38
A-6f. PAGE 6 OF 7....A-39
A-6g. PAGE 7 OF 7....A-40
A-7. TYPICAL TRANSDUCER SPECIFICATIONS....A-41
A-8. +Gz TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION
A-8a. PAGE 1 OF 2....A-42
A-8b. PAGE 2 OF 2....A-43
A-9. +Gy AND -Gx TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION
A-9a. PAGE 1 OF 2....A-44
A-9b. PAGE 2 OF 2....A-45
A-10. SMALL JPATS MANIKIN TRANSDUCER PRE- AND POST-CALIBRATION
A-10a. PAGE 1 OF 2....A-46
A-10b. PAGE 2 OF 2....A-47
A-11. LARGE JPATS MANIKIN TRANSDUCER PRE- AND POST-CALIBRATION
A-11a. PAGE 1 OF 2....A-48
A-11b. PAGE 2 OF 2....A-49
A-12. LARGE ADAM MANIKIN TRANSDUCER PRE- AND POST-CALIBRATION
A-12a. PAGE 1 OF 2....A-50
A-12b. PAGE 2 OF 2....A-51

LIST OF ILLUSTRATIONS

FIGURE PAGE

A-1. AL/CFBE VERTICAL DECELERATION TOWER....A-52
A-2. HORIZONTAL IMPULSE ACCELERATOR ACTUATOR....A-53
A-3. +Gz SEAT CONFIGURATION (VIP SEAT FIXTURE)....A-54
A-4. +Gz TEST CONFIGURATION WITH SUBJECT'S LIMBS UNRESTRAINED...A-55
A-5. +Gz TEST CONFIGURATION WITH SUBJECT'S LIMBS RESTRAINED.....A-56
A-6. +Gy TEST CONFIGURATION FOR CELL F TESTS....A-57
A-7. +Gy TEST CONFIGURATION FOR CELL G AND G1 TESTS....A-58
A-8. +Gy TEST CONFIGURATION FOR CELL H AND I TESTS....A-59
A-9. -Gx TEST CONFIGURATION FOR CELL J TESTS....A-60
A-10. -Gx TEST CONFIGURATION FOR CELL J1 TESTS....A-61
A-11. -Gx TEST CONFIGURATION FOR CELL K THROUGH P TESTS....A-62
A-12. AL/CFBE +Gz TEST CONFIGURATION COORDINATE SYSTEM....A-63
A-13. AL/CFBE +Gy AND -Gx TEST CONFIGURATION COORDINATE SYSTEM...A-64
A-14. AL/CFBE SLED COORDINATE SYSTEM....A-65
A-15. MANIKIN COORDINATE SYSTEM....A-66
A-16. EXTERNAL CHEST ACCELEROMETER PACKAGE....A-67
A-17. +Gz TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS
A-17a. PAGE 1 OF 2....A-68
A-17b. PAGE 2 OF 2....A-69
A-18. +Gy TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS
A-18a. PAGE 1 OF 2....A-70
A-18b. PAGE 2 OF 2....A-71
A-19. HIP LOAD CELL ADJUSTMENT BRACKETS....A-72
A-20. RIGHT KNEE LOAD CELL ADJUSTMENT BRACKETS....A-73
A-21. +Gy AND -Gx TEST CONFIGURATION (CONTOURED SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS
A-21a. PAGE 1 OF 2....A-74
A-21b. PAGE 2 OF 2....A-75
A-22. -Gx TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS
A-22a. PAGE 1 OF 2....A-76
A-22b. PAGE 2 OF 2....A-77
A-23. HIP AND KNEE LOAD CELL INSTRUMENTATION....A-78
A-24. ADACS INSTALLATION (+Gz TEST CONFIGURATION)....A-79
A-25. AUTOMATIC DATA ACQUISITION AND CONTROL SYSTEM....A-80
A-26. DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM....A-81
A-27. EME DAS-64 INSTALLATION (+Gy AND -Gx TEST CONFIGURATION)...A-82
A-28. EME DAS-64 DATA ACQUISITION SYSTEM....A-83
A-29. EME DAS-64 DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM....A-84
A-30. ONBOARD SELSPOT CAMERA LOCATIONS (+Gz TEST CONFIGURATION)..A-85
A-31. ONBOARD SELSPOT CAMERA LOCATIONS (+Gy TEST CONFIGURATION)..A-86
A-32. ONBOARD SELSPOT CAMERA LOCATIONS (-Gx TEST CONFIGURATION FOR CELLS J AND J1)....A-87

LIST OF ILLUSTRATIONS (CONTINUED)

FIGURE PAGE

A-33. ONBOARD SELSPOT CAMERA LOCATIONS (-Gx TEST CONFIGURATION FOR CELLS K AND L)........A-88
A-34. SELSPOT COMPUTER SYSTEM........A-89
A-35. POSITION REFERENCE STRUCTURE (PRS)........A-90
A-36. +Gz TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS.....A-91
A-37. +Gz TEST CONFIGURATION INFRARED TARGETS........A-92
A-38. +Gy TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS
A-38a. PAGE 1 OF 2........A-93
A-38b. PAGE 2 OF 2........A-94
A-39. +Gy TEST CONFIGURATION INFRARED TARGETS (FOR CELL F TESTS).A-95
A-40. +Gy TEST CONFIGURATION INFRARED TARGETS (FOR CELL H AND I TESTS)........A-96
A-41. +Gy TEST CONFIGURATION INFRARED TARGETS (FOR CELL G AND G1 TESTS)........A-97
A-42. -Gx TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS (FOR CELL J AND J1 TESTS)........A-98
A-43. -Gx TEST CONFIGURATION INFRARED TARGETS (FOR CELL J AND J1 TESTS)........A-99
A-44. -Gx TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS (FOR CELL K AND L TESTS)........A-100
A-45. -Gx TEST CONFIGURATION INFRARED TARGETS (FOR CELL K AND L TESTS)........A-101
A-46. SELSPOT MOTION ANALYSIS SYSTEM........A-102
A-47. KODAK EKTAPRO 1000 VIDEO SYSTEM........A-103

INTRODUCTION

This report was prepared by DynCorp for the Armstrong Laboratory (AL/CFBE) under Air Force Contract F33601-96-DJ001.

The information provided herein describes the test systems, seat fixtures, restraint configurations, test subjects, test configurations, data acquisition, and the instrumentation procedures that were used in the Impact Testing of the JPATS Manikins During -Gx, +Gy and +Gz Impact Accelerations (JPATS Study) Test Program on the Horizontal Impulse Accelerator and Vertical Deceleration Tower during January through May 1995.

1. TEST SYSTEMS

Tests were conducted on two separate Impact Systems, the Vertical Deceleration Tower as described in Section 1.1 and the Horizontal Impulse Accelerator as described in Section 1.2.

Fifty-four tests were conducted on the Vertical Deceleration Tower in the +Gz Test Configuration. One hundred thirteen tests were conducted on the Horizontal Impulse Accelerator: fifty-one in the +Gy Test Configuration and sixty-two in the -Gx Test Configuration.

1.1 Vertical Deceleration Tower

The AL/CFBE Vertical Deceleration Tower, as shown in Figure A-1, was used for all of the +Gz Test Configuration tests.

The system consists of a 60-foot vertical steel tower which supports a guide rail system, an impact carriage supporting a plunger, a hydraulic deceleration device and a test control and safety system. The impact carriage can be raised to a maximum height of 39 feet prior to release. After release, the carriage free falls until the plunger, attached to the undercarriage, enters a water-filled cylinder mounted at the base of the tower. The deceleration profile produced as the plunger displaces the water in the cylinder is determined by the free fall distance, the carriage and test specimen mass, the shape of the plunger and the size of the cylinder orifice. A rubber bumper is used to absorb the final impact as the carriage stops. For these tests, plunger number 102 was mounted under the carriage. Drop height varied from 11'2" to 31'4".

1.2 Horizontal Impulse Accelerator

The AL/CFBE Horizontal Impulse Accelerator System was used for the one hundred thirteen +Gy and -Gx Test Configuration tests. The Horizontal Impulse Accelerator System consists of the 24-inch HYGE actuator, the test sled and 240 feet of track. The Horizontal Impulse Accelerator is designed to simulate an impact profile by accelerating the test sled down the track.

The energy required to produce the impact acceleration is generated within the actuator cylinder (Figure A-2) by means of differential gas pressures acting upon a thrust piston. This thrust piston is attached to a thrust column assembly, which is used to impact the sled. As pressure moves the thrust assembly, the sled is accelerated from an initial stationary position to a predetermined peak acceleration level and is then allowed to decelerate by coasting or by brake application. Various acceleration profiles may be obtained by changing the differential pressures, the travel length of the thrust assembly and the metering structure on the thrust piston. The sled glides along the track rails on twelve glide pads. The sled braking system consists of caliper brakes, which grip the track rails when activated by onboard compressed nitrogen gas. The track rails are one inch thick and the

total track length is 240 feet. Several metering pins were used to obtain the desired acceleration profiles.

2. SEAT FIXTURES

Two separate seat fixtures were used during this test program. The VIP seat, as described in Section 2.1, was used for the +Gz Test Configuration on the Vertical Deceleration Tower. The 40 G seat, as described in Section 2.2, was used for the +Gy and -Gx Test Configurations on the Horizontal Impulse Accelerator.

2.1 VIP Seat Fixture

The VIP seat fixture, as shown in Figure A-3, was used for all of the tests. The seat was designed to withstand vertical impact accelerations up to 50 G. The adjustable seat back was not adjusted during this study as all of the tests were run at the 0 degree seat back angle. The headrest was mounted in-line with the seat back. When positioned in the seat, the subject's upper legs were bent 90 degrees outward to a horizontal position with his lower legs bent downward. The subject was secured in the seat with a standard USAF double shoulder strap restraint harness and lap belt configuration. The shoulder harness was attached to the seat fixture with either a Single-T or Single-V attachment configuration, as indicated in Table A-1. The lap belt and shoulder straps were preloaded to 20 ±5 pounds for the Small JPATS and Large ADAM manikins, as required in the test plan. However, tension for the Large JPATS manikin was increased to 25 ±5 pounds due to the tendency of the manikin to lean too far forward and to the right.

The subject's limbs were unrestrained, with hands folded right over left and resting on the lap (except cell A tests). Figure A-4 illustrates the subject's unrestrained limbs.

For cell A tests, each of the subject's legs were restrained by a strap that encircled the subject's calf and was attached to the carriage. Another strap crossed the subject's thighs and attached to the seat pan posterior to the knees. The subject's hands were placed under the thigh restraint. These restraints are illustrated by Figure A-5.

2.2 40 G Seat Fixture

The 40 G seat fixture was used in both the +Gy and -Gx Test Configurations, as described in Sections 2.2.1 and 2.2.2 respectively.

The subjects were secured in the seat with a PCU-15/P (large ADAM and large JPATS manikin tests) or PCU-16/P (small JPATS manikin tests) restraint harness, two shoulder straps and an ACES II lap belt. The shoulder harness was attached to the seat fixture with either a Single-V or Double attachment configuration, as indicated in Table A-1. The lap belts and shoulder straps were preloaded to 20 ±5 pounds, as required in the test plan. An exception was made for the small JPATS manikin in cells J and J1 where tensions of 15 ±5 pounds were employed since the small size of the manikin did not permit the higher tensions to be achieved in this configuration.

Ballast was used on the sled to keep the total weight of the sled and subject constant. The amount of ballast was equal to two-hundred forty-eight pounds minus the weight of the test subject.

The headrest was mounted in-line with the seat back on all 40 G seat configurations.

2.2.1 +Gy Seat Fixture Configurations
The experimental seat fixture was the 40 G seat mounted on the Horizontal Impulse Accelerator Sled and was oriented to provide a +Gy acceleration vector. Three seat fixture configurations were used as described below.

The seat fixture for cell F tests had a flat seat pan and seat back. The seat back angle was 13 degrees aft of vertical and the seat pan was 6 degrees above horizontal. Instrumented leg and hip panels provided lower body restraint. A strap encircled each of the subject's thighs and the subject's hands were placed under the thigh restraint. Figure A-6 illustrates the seat fixture/test configuration for cell F tests.

The seat fixture for cell G and G1 tests had a contoured seat pan and seat back. The seat back angle was 13 degrees aft of vertical and the seat pan was 13 degrees above horizontal. The subject's limbs were unrestrained, with hands folded right over left and resting on the lap. Figure A-7 illustrates the seat fixture/test configuration for cell G and G1 tests.

The seat fixture for cell H and I tests is the same seat fixture used for cell G and G1 tests with an exception. Uninstrumented leg and hip panels provided lower body restraint. The subject's limbs were unrestrained, with hands folded right over left and resting on the lap. Figure A-8 illustrates the seat fixture/test configuration for cell H and I tests.

2.2.2 -Gx Seat Fixture Configurations
The experimental seat fixture was the 40 G seat mounted on the Horizontal Impulse Accelerator Sled and was oriented to provide a -Gx acceleration vector. Three seat fixture configurations were used as described below.

The seat fixture for cell J tests had a flat seat pan and seat back. The seat back angle was zero degrees (vertical) and the seat pan was horizontal. Each foot of the subject was restrained by a strap that encircled the subject's foot and was attached to the foot pedal. Another strap encircled each of the subject's thighs. The subject's hands were placed under the thigh restraint. Figure A-9 illustrates the seat fixture/test configuration for cell J tests.

The seat fixture for cell J1 tests is the same seat fixture used for cell J with an exception. The foot pedals were not used and the subject's limbs were unrestrained, with hands folded right over left and resting on the lap. Figure A-10 illustrates the seat fixture/test configuration for cell J1 tests.

The seat fixture for cell K through P tests had a contoured seat pan and seat back. The seat back angle was 13 degrees aft of vertical and the seat pan was 13 degrees above horizontal. A 17 degree wedge was placed under the seat fixture, making the seat back angle 30 degrees aft of vertical and the seat pan 30 degrees above horizontal. The subject's limbs were unrestrained, with hands folded right over left and resting on the lap. Figure A-11 illustrates the seat fixture/test configuration for cell K through P tests.

3. TEST SUBJECTS

Four manikins were used during this test program as follows:

1. One small (modified 5th percentile female Hybrid III) JPATS manikin.
2. One large (modified 95th percentile male Hybrid III) JPATS manikin.

3. One Advanced Dynamic Anthropomorphic Manikin (ADAM) representative of the "large" flying population.
4. One 95th percentile Alderson manikin, designated VIP-95.

All manikins wore a standard HGU-55/P helmet. An oxygen mask (MBU-12/P) was employed in all test cells except A, F, J and J1.

4. TEST CONFIGURATIONS

Eighteen test cells were used, as listed in Table A-1.

5. INSTRUMENTATION

The electronic data collected during this test program is described in Sections 5.1 and 5.2. Section 5.1 discusses accelerometers while Section 5.2 discusses load transducers. Section 5.3 discusses the calibration procedures that were used.

The external measurement instrumentation used in this test program is listed in Tables A-2 and A-3. These figures correspond to the +Gz Test Configuration, and the +Gy and -Gx Test Configurations respectively. The internal manikin measurement instrumentation used in this test program is listed in Tables A-4 through A-6. These figures correspond to the Small JPATS manikin, Large JPATS manikin, and Large ADAM manikin internal instrumentation respectively. These figures designate the manufacturer, type, serial number, sensitivity and other pertinent data on each transducer used. Table A-7 lists the manufacturer's typical transducer specifications.

Accelerometers and load transducers were chosen to provide the optimum resolution over the expected test load range. Full scale data ranges were chosen to provide the expected full scale range plus 50% to assure the capture of peak signals. All transducer bridges were balanced for optimum output prior to the start of the program. The accelerometers were adjusted for the effect of gravity using computer processing software. The component of a 1 G vector in line with the force of gravity that lies along the accelerometer axis was added to each accelerometer.

The accelerometer and load transducer coordinate systems for all three Test Configurations are shown in Figures A-12 and A-13. The seat coordinate system is right-handed with the z axis parallel to the seat back and positive upward. The x axis is perpendicular to the z axis and positive eyes forward from the subject. The y axis is perpendicular to the x and z axes according to the right hand rule. The origin of the seat coordinate system is designated as the seat reference point (SRP). The SRP is at the midpoint of the line segment formed by the intersection of the seat pan and seat back. All vector components (for accelerations, forces, moments, etc.) were positive when the vector component (x, y and z) was in the direction of the positive axis.

The linear accelerometers were wired to provide a positive output voltage when the acceleration experienced by the accelerometer was applied in the +x, +y and +z directions, as shown in Figures A-12 and A-13.

The load cells were wired to provide a positive output voltage when the force exerted by the load cell on the subject was applied in the +x, +y or +z direction, as shown in Figures A-12 and A-13.

For the +Gz Test Configuration, all transducers except the carriage accelerometers and the carriage velocity tachometer were referenced to the seat coordinate system. The carriage velocity tachometer was wired to

provide a positive output voltage during freefall. The carriage accelerometers were referenced to the carriage coordinate system, as shown in Figure A-12.

For the +Gy and -Gx Test Configurations, all transducers except the sled accelerometers and the sled velocity tachometer were referenced to the seat coordinate system. The sled accelerometers and the sled velocity tachometer were referenced to the sled coordinate system, as shown in Figure A-14. The x axis is horizontal and positive down track from the Horizontal Impulse Accelerator. The z axis is vertical and positive upward. The y axis is perpendicular to the x and z axes according to the right hand rule.

The sled linear accelerometers were wired to provide a positive output voltage when the acceleration experienced by the accelerometer is applied in the +x, +y or +z directions, as shown in Figure A-14.

The sled velocity tachometer was wired to provide a positive output voltage when the sled moves in the +x direction, as shown in Figure A-14.

The manikin internal transducers were referenced to the manikin coordinate system, which is shown in Figure A-15.

The manikin neck load cell was wired to provide a positive output voltage when the force exerted by the load cell, on the neck, was applied in the +x, +y or +z directions, as shown in Figure A-15.

The manikin Mx, My and Mz torque transducers were wired to provide a positive output voltage when the torque experienced by the transducer was applied in the +x, +y or +z direction according to the right hand rule, as shown in Figure A-15.

The carriage velocity and sled velocity were measured using Globe Industries tachometers Model 22A672-2. The rotor of the tachometer was attached to an aluminum wheel with a rubber "O" ring around its circumference to assure good rail contact. The wheel contacted the track rail and rotated as the carriage (or sled) moved, producing an output voltage proportional to the velocity.

5.1 Accelerometers

The following sections describe the accelerometer instrumentation, as required in the AL/CFBE test plan.

5.1.1 +Gz Test Configuration

The external chest accelerometer package consisted of three Endevco Model 7264-200 linear accelerometers mounted to a 1/2 x 1/2 x 1/2 inch aluminum block for accelerations in the x, y and z directions. The accelerometers packages were inserted into a steel protection shield to which a length of Velcro fastener strap was attached. The package was placed over the subject's sternum at the level of the xiphoid and was held there by fastening the Velcro strap around the subject's chest. An infrared LED chest target was attached directly on the side of the chest accelerometer package that faces the Selspot cameras. Figure A-16 illustrates the chest accelerometer package.

Carriage accelerations were measured using three Endevco linear accelerometers: one model 2262A-200 for acceleration in the z direction and two models 2264-200 for accelerations in the x and y directions. The three accelerometers were mounted on a small acrylic block and located behind the seat on the VIP seat structure.

Seat accelerations were measured using three Endevco linear accelerometers: one Model 2264-200 for acceleration in the x direction and two models 7264-200 for accelerations in the y and z directions. The three linear accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted near the center of the load cell mounting plate.

5.1.2 +Gy and -Gx Test Configurations

The external chest accelerometer package consisted of three Entran Model EGE-72B-200 linear accelerometers mounted to a 1/2 x 1/2 x 1/2 inch aluminum block for accelerations in the x, y and z directions. The accelerometers were inserted into a steel protection shield to which a length of Velcro fastener strap was attached. The package was placed over the subject's sternum at the level of the xiphoid and was held there by fastening the Velcro strap around the subject's chest. Figure A-16 illustrates the chest accelerometer package.

Sled accelerations were measured using one Endevco Model 2262A-200 linear accelerometer for acceleration in the x direction and two Entran model EGE-72B-200 for accelerations in the y and z directions. The three accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted on the underside center of the sled.

Seat accelerations were measured using one Entran Model EGE-72B-200 linear accelerometer for acceleration in the x direction and two Endevco Model 7264-200 linear accelerometers for accelerations in the y and z directions. The three linear accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted near the center of a bracket mounted under the seat pan.

5.1.3 Manikin Accelerometers

The following sections describe the manikin accelerometer instrumentation, as required in the AL/CFBE test plan.

5.1.3.1 JPATS Manikin Accelerometers

The internal chest accelerometers consisted of three Entran Model EGV3-F-250 linear accelerometers for accelerations in the x, y and z directions. These accelerometers were mounted in the chest cavity of the small and large JPATS manikins.

Manikin head accelerations were measured using three Entran Model EGV3-F-250 linear accelerometers for accelerations in the x, y and z directions. These accelerometers were internally mounted in the head of the small and large JPATS manikins.

The internal pelvis accelerometers consisted of three Entran Model EGV3-F-250 linear accelerometers for accelerations in the x, y and z directions. These accelerometers were mounted in the pelvis area of the small and large JPATS manikins.

5.1.3.2 Large Adam Manikin Accelerometers

The internal chest accelerometers consisted of three Entran Model EGA-125F-100D linear accelerometers for accelerations in the x, y and z directions. These accelerometers were mounted in the chest cavity of the large ADAM manikin.

Manikin head accelerations were measured using three Entran Model EGA-125F-100D linear accelerometers for accelerations in the x, y and z directions.

These accelerometers were internally mounted in the head of the large ADAM manikin.

The internal pelvis accelerometers consisted of three Entran Model EGA-125F-100D linear accelerometers for accelerations in the x, y and z directions. These accelerometers were mounted in the pelvis area of the large ADAM manikins.

5.2 Load Transducers

The following sections describe the load transducer instrumentation, as required in the AL/CFBE test plan.

5.2.1 +Gz Test Configuration

The load transducer locations and dimensions for the +Gz Test Configuration are shown in Figures A-17a and A-17b.

Shoulder/anchor forces were measured using three AAMRL/DYN 3D-SW triaxial load cells, each capable of measuring forces in the x, y and z directions. The parameters measured are indicated below:

Shoulder x, y and z force
Left lap belt x, y and z force
Right lap belt x, y and z force

The lap anchor force triaxial load cells were located on separate brackets mounted on the side of the seat frame parallel to the seat pan.

The shoulder strap force triaxial load cell was mounted on the seat frame between the seat back support plate and the headrest.

Left, right and center seat pan forces were measured using three Strainsert Model FL2.5U-2SPKT load cells for measuring loads in the z direction. The load cells were located under the seat pan support plate.

5.2.2 +Gy and -Gx Test Configuration

The load transducer locations and dimensions for the +Gy and -Gx Test Configurations are shown as follows:

1) +Gy Test Configuration (Flat Seat) - Figures A-18a and A-18b.
2) +Gy and -Gx Test Configuration (Contoured Seat) - Figures A-21a and A-21b.
3) -Gx Test Configuration (Flat Seat) - Figures A-22a and A-22b.

Shoulder/anchor forces were measured using four AAMRL/DYN 3D-SW triaxial load cells, each capable of measuring forces in the x, y and z directions. The parameters measured are indicated below:

Left Shoulder x, y and z force
Right Shoulder x, y and z force
Left lap belt x, y and z force
Right lap belt x, y and z force

The lap anchor force triaxial load cells were located on separate brackets mounted on the side of the seat pan frame.

The shoulder strap force triaxial load cell(s) were mounted on the seat frame between the seat back support plate and the headrest.

Left and right knee forces and right hip forces were measured using three Strainsert Model FL2.5U-2SPKT load cells for the +Gy Test Configuration with the flat seat. All three measurement devices were located on their respective mounting brackets. The Strainsert load cells were used for measuring loads in the y direction. The hip and knee instrumentation can be seen in Figure A-23.

5.2.3 Manikin Load Transducers

For small JPATS manikin, large JPATS manikin and large ADAM manikin tests, Neck x, y and z forces and Mx, My and Mz torques were measured using a Denton Model 1716 load cell. Lumbar x, y and z forces and Mx, My and Mz torques were measured using a Denton Model 1914 load cell. These load cells were internally mounted in the manikins.

5.3 Calibration

Calibrations were performed before and after testing to confirm the accuracy and functional characteristics of the transducers. Pre-program and post-program calibrations are given as follows:

1) +Gz Test Configuration - Tables A-8a and A-8b.
2) +Gy and -Gx Test Configuration - Tables A-9a and A-9b.
3) Small JPATS Manikin - Tables A-10a and A-10b.
4) Large JPATS Manikin - Tables A-11a and A-11b.
5) Large ADAM Manikin - Tables A-12a and A-12b.

The calibration of all Strainsert load cells was performed by the Precision Measurement Equipment Laboratories (PMEL) at Wright-Patterson Air Force Base. PMEL calibrated these devices on a periodic basis and provided current sensitivity and linearity data.

The calibration of the accelerometers was performed by DynCorp using the comparison method (Ensor, 1970). A laboratory standard accelerometer, calibrated on a yearly basis by Endevco with standards traceable to the National Bureau of Standards, and a test accelerometer were mounted on a shaker table. The frequency response and phase shift of the test accelerometer were determined by driving the shaker table with a random noise generator and analyzing the outputs of the accelerometers with a Unisys 386/25 computer using Fourier analysis. The natural frequency and the damping factor of the test accelerometer were determined, recorded and compared to previous calibration data for that test accelerometer. Sensitivities were calculated at 40 G and 100 Hertz. The sensitivity of the test accelerometer was determined by comparing its output to the output of the standard accelerometer.

The shoulder/lap/head/leg triaxial load cells were calibrated by DynCorp. These transducers were calibrated to a laboratory standard load cell in a special test fixture. The sensitivity and linearity of each test load cell were obtained by comparing the output of the test load cell to the output of the laboratory standard under identical loading conditions. The laboratory standard load cell, in turn, is calibrated by PMEL on a periodic basis.

The velocity wheel is calibrated periodically by DynCorp by rotating the wheel at approximately 2000, 4000 and 6000 revolutions per minute (RPM) and recording both the output voltage and the RPM.

6. DATA ACQUISITION

Data acquisition was controlled by a comparator on the Master Instrumentation Control Unit in the Instrumentation Station. The test was initiated when the comparator countdown clock reached zero. The comparator was set to start data collection at a preselected time.

A reference mark pulse was generated to mark the electronic data and Selspot optical motion data at a preselected time after test initiation to place the reference mark close to the impact point. The reference mark time was used as the start time for data processing of the electronic and Selspot optical motion data.

Prior to each test and prior to placing the subject in the seat, data were recorded to establish a zero reference for all data transducers. These data were stored separately from the test data and were used in the processing of data.

6.1 Automatic Data Acquisition and Control System (ADACS)

The Automatic Data Acquisition and Control System (ADACS) was used on the Vertical Deceleration Tower for the +Gz Test Configuration. Installation of the ADACS instrumentation is shown in Figure A-24. The three major components of the ADACS system are the power conditioner, signal conditioners and the encoder. A block diagram of the ADACS is shown in Figure A-25. The signal conditioners contain forty-eight amplifiers with programmable gain and filtering.

Bridge excitation for load cells and accelerometers was 10 VDC. Bridge completion and balance resistors were added, as required, to each module input connector.

The forty-eight module output data signals were digitized and encoded into forty-eight 11-bit digital words. Two additional 11-bit synchronization (sync) words were added to the data frame making a fifty word capability.

Three synchronization pulse trains (bit sync, word sync and frame sync) were added to the data frame and sent to the computer via a junction box data cable.

The Data Acquisition, Storage and Analysis Computer Subsystem includes a Gateway 486 computer and the DEC 3000-500 AXP Alpha computer. The Gateway 486 computer replaces the PDP 11/34 minicomputer that was previously used to collect the ADACS test data. The Gateway 486 computer communicates with the Real Time Data Acquisition and Control Subsystem using an AT-DIO-32F digital I/O board. The AT-DIO-32F board receives the real time ADACS binary test data as 16 bit parallel words from the data formatter. The ADACS binary data is stored by the AT-DIO-32F board in the memory of the Gateway 486 using direct memory access (DMA).

The Gateway 486 computer is an IBM compatible PC with an MSDOS Version 5.0 Operating System. The ADACS test data is acquired using a data collection program written using the C programming language. The data collection program acquires the ADACS test data using the AT-DIO-32F digital I/O board, reformats the data for the DEC 3000-500 processing software, and writes the result to a binary data file. The program includes options to compute and store zero reference voltage values, collect and store a binary zero reference data file, compute and display preload values, and collect and store binary test data.

The data collection program transfers the ADACS test data from memory to a temporary ram disk file. The data is then reformatted to match the format

of the ADACS test data that was collected using the BDC board in the PDP 11/34 computer. This allows the data to be analyzed using the same DEC 3000-500 AXP Alpha analysis software that was used to analyze the ADACS test data from the PDP 11/34.

The Gateway 486 computer communicates with the DEC 3000-500 AXP Alpha computer through a thin wire Ethernet network. The test data are transferred from the Gateway 486 computer to the DEC 3000-500 AXP Alpha computer through the Ethernet network and output to optical disk for permanent storage. The interrelationships among the data acquisition and storage equipment are shown in Figure A-26.

The test data can be reviewed immediately after each test by using the "quick look" SCAN routine. SCAN produces a plot of the test data for each channel in engineering units as a function of time. SCAN determines the minimum and maximum values for each channel and outputs a summary sheet containing the results. It also calculates the rise time and pulse duration for the carriage acceleration, and creates a text data base file containing significant test parameters.

6.2 EME DAS-64 Data Acquisition and Storage System

The EME DAS-64 Data Acquisition and Storage System was used on the Horizontal Impulse Accelerator for the +Gy and -Gx Test Configuration. The EME DAS-64 Data Acquisition System, manufactured by EME Corporation, was used for this test program. The EME DAS-64 Data Acquisition System is a ruggedized signal conditioning and recording system for transducers and events. The system is powered by an external 19 Volt DC power supply and communicates with the host Gateway 486 computer through an RS-422 interface. The DAS-64 contains 4 Mbyte of onboard memory, which can hold 129,000 test data samples per channel for 64 channels.

The EME DAS-64 is designed to withstand a 60 G 100 ms shock from a half sine shock profile in the three primary axes. The EME DAS-64 is also designed to withstand a 10-2000 Hz sine sweep with an amplitude of up to 60 G. Installation of the EME DAS-64 on the sled is shown in Figure A-27.

The EME DAS-64 will accommodate up to 64 transducer channels and 16 events. The signal conditioning front end excites, amplifies and offsets transducer input signals to appropriate levels for analog to digital conversion. Transducer signals are amplified, filtered, digitized and recorded in onboard solid state memory. A block diagram of the EME DAS-64 is shown in Figure A-28.

The high speed RS-422 board installed in the Gateway 486 computer communicated with the EME DAS-64 with a transfer rate of 1 Mbit/sec. The Gateway 486 computer configured the DAS-64 before the test and retrieved the test data from the onboard memory in the DAS-64 after the test was completed. The test data were later transferred to the DEC 3000-500 Alpha AXP through the thin wire Ethernet network and output to optical disk for permanent storage. The interrelationships among the DAS-64 data acquisition, data analysis and data storage equipment are shown in Figure A-29.

The C program ADASEME on the Gateway 486 computer configured the DAS-64 prior to the start of the test, transferred test data from the EME DAS-64 when the test is completed, and stored the collected test data in a binary data file. The program is organized into 5 menu options. The menu options are: test setup, diagnostics, transducer calibration, test data conversion, view graphs, and test data collection. The program communicated with the EME DAS-64 Data Acquisition System by sending instruction over the RS-422 interface.

Test data could be reviewed after it was converted to digital format using the "quick look" SCAN_EME routine on the DEC 3000-500 Alpha AXP computer. SCAN_EME produced a plot of the data stored for each channel as a function of time. The routine determined the minimum and maximum values of each data plot. It also calculated the rise time, pulse duration, and carriage acceleration, and created a disk file containing significant test parameters.

6.3 Manikin Internal Data Acquisition System

The small JPATS manikin, large JPATS manikin and the large ADAM manikin each had an internal data acquisition system to collect test data from the internal manikin transducers. The signal conditioning front end excites, amplifies and offsets transducer input signals to appropriate levels for analog to digital conversion. Transducer signals are amplified, filtered, digitized and recorded in onboard solid state memory. The Gateway 486 computer retrieved the test data from the onboard memory after the test was completed. The test data were later converted to ASCII text files and transferred to the DEC 3000-500 AXP Alpha computer for analysis. The test data was analyzed using the Fortran programs JPATSVDT1 AND JPATSHAC.

6.4 Selspot Motion Analysis System

The Selspot Motion Analysis System was used for all tests with nominal G levels of 20 G or less.

The Selspot Motion Analysis System utilizes photosensitive cameras to track the motion of infrared LED targets attached to different points on the test fixture. The three-dimensional motion of the LEDs was determined by combining the images from two different Selspot cameras.

For the +Gz Test Configuration tests conducted on the Vertical Deceleration Tower, two Selspot cameras were mounted onboard the carriage. The side camera was a Selspot Model 412 (S/N 457) and the oblique camera was a Selspot Model 412 (S/N 458). Both cameras had 24 mm lenses. The Selspot cameras are shown in Figure A-30.

For the +Gy Test Configuration tests conducted on the Horizontal Impulse Accelerator, two Selspot cameras were mounted onboard the sled. The left oblique camera was a Selspot Model 411-2 (S/N 385) and the right oblique camera was a Selspot Model 411-2 (S/N 384). Both cameras had 24 mm lenses. The Selspot cameras are shown in Figure A-31.

For the -Gx Test Configuration tests conducted on the Horizontal Impulse Accelerator, two Selspot cameras were mounted onboard the sled. The side camera was a Selspot Model 411-2 (S/N 385) and the oblique camera was a Selspot Model 411-2 (S/N 384). Both cameras had 24 mm lenses. The Selspot cameras are shown in Figures A-32 (for cells J and J1) and A-33 (for cells K and L).

The Selspot System includes a ZCM 1450 video monitor and a Zenith Data Systems Z Select 100 microcomputer with 16 Mbyte RAM, HW VCU-2 VME Control Unit II, a camera interface module (MCIM), a 3.5" 1.44 Mbyte floppy disk drive, and a 404 Mbyte hard disk drive. The Selspot Computer System is shown in Figure A-34. The microcomputer uses the MS DOS 6.22 operating system. The Selspot data collection and processing are performed by the Selspot MULTILAB System software. The Selspot test data is transferred over the network to the optical disk drive on the DEC 3000-500 AXP Alpha computer for permanent storage.

The Selspot System was calibrated by determining the camera locations and orientations prior to the start of the test program. The camera locations

and orientations were referenced to the coordinate system of the Position Reference Structure (PRS). The PRS is shaped as a tetrahedron with reference LEDs 1, 2, 3 and 4 located at the vertices. The PRS is shown in Figure A-35.

For the +Gz Test Configuration, conducted on the Vertical Deceleration Tower, motion of the subjects' knee, hip, cheek, elbow, shoulder and chest were quantified by tracking the motion of six subject-mounted LEDs. Four reference LEDs were placed on the test fixture. Figures A-36 and A-37 identify the LED target locations.

For the +Gy Test Configuration, conducted on the Horizontal Impulse Accelerator, motion of the subjects' forehead, mouth, left shoulder, right shoulder chest and waist were quantified by tracking the motion of six subject-mounted LEDs. Four reference LEDs were placed on the test fixture. Figures A-38 through A-41 identify the LED target locations.

For the -Gx Test Configuration, conducted on the Horizontal Impulse Accelerator, motion of the subjects' knee, hip, chin, elbow, shoulder and chest were quantified by tracking the motion of six subject-mounted LEDs. Four reference LEDs were placed on the test fixture. Figures A-42 through A-45 identify the LED target locations.

The locations of the LEDs generally followed the guidelines provided in "Film Analysis Guides for Dynamic Studies of Test Subjects, Recommended Practice (SAE J138, March 1980)."

Photogrammetric data was collected from the six moving and four reference LEDs at a 500 Hz sample rate during the impact. Data collection started at T = -2 seconds for 5 seconds. The photogrammetric data was copied to an optical disk for permanent storage.

The data was processed starting at the reference mark time for 600 milliseconds on the Selspot Motion Analysis System, shown in the block diagram in Figure A-46. The camera image coordinates were corrected for camera vibration, converted into three-dimensional coordinates, and transformed into the seat coordinate seat.

A Kodak Ektapro 1000 video system was also used to provide onboard coverage of each test with nominal G levels of 20 G or less. The Kodak camera was mounted offboard for tests with nominal G levels greater than 20 G. This video recorder and display unit are capable of recording high-speed motion up to a rate of 1000 frames per second. The Kodak Ektapro 1000 Video System (less camera) is shown in Figure A-47. Immediate replay of the impact is possible in real time or in slow motion.

7. PROCESSING PROGRAMS

7.1 Processing Programs - Vertical Deceleration Tower
The executable image for the ADACS processing program is located in directory PROCESS of the DEC 3000-500 AXP Alpha computer and the test data is assumed to be stored in logical directory DATADIR. All plots and the test summary sheet are output to the LN03 laser printer. The test base file is output to directory PROCESS.

The Fortran program that processes the test data for the JPATS Study (Vertical Deceleration Tower system) is named JPATSVDT. The character string 'JPATS' identifies the study and 'VDT' identifies the system (Vertical Deceleration Tower). Logical directory DATADIR is assumed to contain a zero reference file named '<test no>Z.VDT', a test data file named

'<test no>D.VDT' and a sensitivity file named '<test no>S.VDT'. JPATSVDT assumes that the test data was collected using the ADACS data acquisition system.

JPATSVDT requests the user to enter the total number of tests to be processed and the test number for each test. The default test parameters are retrieved from the header block of the test data file and displayed as a menu on the screen. The user may specify new values for any of the displayed test parameters. The test parameters include the subject ID, weight, age, height and sitting height. Additional parameters include the cell type, nominal G level, subject type (manikin or human) and belt preload status (computed or not computed). If the belt preloads were computed, then the shoulder and lap preloads are also displayed.

JPATSVDT generates time histories for the carriage z axis acceleration; the carriage velocity; the seat x, y and z axis accelerations; the seat z axis DRI; the chest x, y, z, Ry and resultant accelerations; and the chest x, y, z, Ry and resultant accelerations. Time histories are also generated for the shoulder x, y, z and resultant forces; the left lap x, y, z and resultant forces; the right lap x, y, z and resultant forces; the left, right and center seat z forces, and their sum; and the tare corrected seat z axis sum. Values for the preimpact level and the extrema for each time history are stored in the test base file and printed out as a summary sheet for each test. The time histories are also plotted.

The first 50 points following the reference mark are averaged to compute the zero offset levels for the linear accelerometers. The zero offset levels are subtracted from the accelerometer time histories.

The Fortran program JPATSVDT1 analyzes test data collected using the JPATS manikin internal data acquisition systems. JPATSVDT1 assumes that the JPATS manikin test data is stored in time history files. JPATSVDT1 reads in the test parameters (subject ID, nominal G level, cell type, reference mark time, etc) from the base file '<Test No>VDT.TST' that was created by SCAN2.

JPATSVDT1 generates time histories for the JPATS and ADAM manikin internal data channels. Values for the preimpact level and the extrema for each time history are stored in the test base file and printed out as a summary sheet for each test. The time histories are also plotted.

7.2 Processing Programs - Horizontal Impulse Accelerator
The Fortran program that processes the test data for the JPATS Study (Horizontal Impulse Accelerator system) is named JPATSHAC. The character string 'JPATS' identifies the study and 'HAC' identifies the system (Horizontal Impulse Accelerator). Logical directory DATADIR is assumed to contain a sensitivity file named '<test no>S.HAC' and a test data file named '<test no>D.HAC'. JPATSHAC assumes that the test data was collected using the EME data acquisition system.

JPATSHAC generates time histories for the sled x, y and z axis accelerations; the sled velocity; the seat x, y and z axis accelerations; and the chest x, y, z, and resultant accelerations. Time histories are also generated for the left shoulder x, y z and resultant forces; the right shoulder x, y, z and resultant forces; the left lap x, y, z and resultant forces; the right lap x, y, z and resultant forces; the left and right knee forces; and the right hip force. For the contoured seat configuration, there is only one triaxial shoulder load cell, and the knee and hip load cells are not present. Values for the preimpact level and the extrema for each time history are stored in the test base file and printed out as a summary sheet for each test. The time histories are also plotted.

The first 200 points at the start of the test data file are averaged to compute the zero offset levels for the linear accelerometers. The zero offset levels are subtracted from the accelerometer time histories.

The Fortran program JPATSHAC1 analyzes the test data collected on the Horizontal Impulse Accelerator system using the JPATS manikin internal data acquisition systems. JPATSHAC1 was developed by modifying JPATSVDT1. JPATSHAC1 assumes that the JPATS manikin test data is stored in time history files. JPATSHAC1 reads in the test parameters (subject ID, nominal G level, cell type, reference mark time, etc) from the base file '<Test No>HAC.TST' that was created by SCAN_EME.

JPATSHAC1 generates time histories for the JPATS manikin internal data channels. Values for the preimpact level and the extrema for each time history are stored in the test base file and printed out as a summary sheet for each test. The time histories are also plotted. Different offsets are used for the x and z axis accelerations depending on the seat angle (determined from the cell type).

TEST CELL	ACCEL AXIS	PEAK ACCEL	TIME (ms)	SEAT PLANE	SEAT ANGLE (DEG)	HARNESS ATTACHMENT	OXYGEN MASK	LIMB RESTRAINT	SIDE PANELS	PIN NO.
A	+Z	10 G	65/150	FLAT	0/0	SINGLE-T	NO	YES	NO	102
B	+Z	10 G	65/150	FLAT	0/0	SINGLE-V	YES	NO	NO	102
C	+Z	15 G	65/150	FLAT	0/0	SINGLE-V	YES	NO	NO	102
D	+Z	20 G	65/150	FLAT	0/0	SINGLE-V	YES	NO	NO	102
E	+Z	24 G	65/150	FLAT	0/0	SINGLE-V	YES	NO	NO	102
F	+Y	7 G	65/150	FLAT	6/13	DOUBLE	NO	YES	YES	11
G1	+Y	6 G	65/150	CONTOUR	13/13	SINGLE-V	YES	NO	NO	11
G	+Y	8 G	65/150	CONTOUR	13/13	SINGLE-V	YES	NO	NO	11
H	+Y	10 G	65/150	CONTOUR	13/13	SINGLE-V	YES	NO	YES	11
I	+Y	14 G	65/150	CONTOUR	13/13	SINGLE-V	YES	NO	YES	11
J	-X	10 G	120/250	FLAT	0/0	DOUBLE	NO	YES	NO	19
J1	-X	10 G	120/250	FLAT	0/0	DOUBLE	NO	NO	NO	19
K	-X	10 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	11
L	-X	20 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	11
M	-X	30 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	2
N	-X	35 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	2
O	-X	45 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	2
P	-X	40 G	65/150	CONTOUR	30/30	SINGLE-V	YES	NO	NO	2

NOTES:

1. TIME: FOR EXAMPLE, 65/150 MEANS 65 ms RISE TIME AND 150 ms PULSE DURATION.
2. SEAT ANGLE (DEGREE): FOR EXAMPLE, 6/13 MEANS SEAT PAN ANGLE 6 DEGREES ABOVE HORIZONTAL AND SEAT BACK ANGLE 13 DEGREES AFT OF VERTICAL.
3. HARNESS ATTACHMENT: THE SHOULDER HARNESS WAS ATTACHED TO THE SEAT FIXTURE WITH EITHER A SINGLE-V, SINGLE-T, OR DOUBLE ATTACHMENT CONFIGURATION AS SHOWN IN THE TEST MATRIX.

TABLE A-1: TEST CELL MATRIX

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gz STUDY) DATES: 24-JAN-95 THRU 13-MAR-95

FACILITY VERTICAL DECELERATION TOWER RUN NUMBERS: 3318 - 3405

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
1	CARRIAGE x ACCEL.	ENDEVCO 2264-200	CB09	2.957 mv/G	10.00 / 1	60 / 1	50 / 3	1K / 1	16.9G	120	2.5V / +5.0 0.0	82K +IN TO GND	1.65K	
2	CARRIAGE y ACCEL.	ENDEVCO 2264-200	BN36	3.282 mv/G	10.00 / 2	60 / 2	50 / 15	1K / 1	15.2G	120	2.5V / +5.0 0.0	80K -IN TO GND	1.0K	
3	CARRIAGE z ACCEL.	ENDEVCO 2262A-200	FR31	5.14 mv/G	10.00 / 3	60 / 3	10 / 10	1K / 1	48.6G	120	2.5V / +5.0 0.0	-	-	
4	SEAT x ACCEL.	ENDEVCO 2264-200	CH74	2.984 mv/G	10.00 / 4	60 / 4	50 / 22	1K / 1	16.8G	120	2.5V / +5.0 0.0	99K +IN TO GND	1.5K	
5	SEAT y ACCEL.	ENDEVCO 7264-200	CC79H	3.296 mv/G	10.00 / 5	60 / 5	50 / 24	1K / 1	15.2G	120	2.5V / +5.0 0.0	-	1.5K	
19	SEAT z ACCEL.	ENDEVCO 7264-200	CM11H	2.754 mv/G	10.00 / 6	60 / 6	10 / 16	1K / 1	90.8G	120	2.5V / +5.0 0.0	-	1.5K	CHANNEL 6, TEST 3318 THRU 3329, BY77H, SENS. = 3.355 mv/G, F.S. = 74.5G
7	EXT. CHEST x ACCEL	ENDEVCO 7264-200	BH76H	3.219 mv/G	10.00 / 7	60 / 7	25 / 31	1K / 1	31.1G	120	2.5V / +5.0 0.0	-	1.5K	
8	EXT. CHEST y ACCEL.	ENDEVCO 7264-200	BH81H	3.265 mv/G	10.00 / 8	60 / 8	25 / 11	1K / 1	30.6G	120	2.5V / +5.0 0.0	-	1.5K	

ADACS EXTERNAL DATA

TABLE A-2a: +Gz TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gz STUDY) DATES: 24-JAN-95 THRU 13-MAR-95

FACILITY VERTICAL DECELERATION TOWER RUN NUMBERS: 3318 - 3405

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
9	EXT. CHEST z ACCEL.	ENDEVCO 7264-200	BH87H	2.987 mv/G	10.00 / 9	60 / 9	10 / 12	1K / 1	83.7G	120	2.5V / +5.0 0.0	105K +IN TO GND	1.5K	
10	LEFT SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	7588-3	8.00 μv/LB	10.00 / 10	60 / 10	100 / 18	1K / 1	3125 LB	120	2.5V / +5.0 0.0	-	-	
11	RIGHT SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	7135-4	7.96 μv/LB	10.00 / 11	60 / 11	100 / 29	1K / 1	3141 LB	120	2.5V / +5.0 0.0	-	-	
12	CENTER SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	3294-6	7.96 μv/LB	10.00 / 12	60 / 12	50 / 12	1K / 1	6281 LB	120	2.5V / +5.0 0.0	-	-	
13	LEFT LAP x LOAD	AAMRL/DYN 3D-SW	24X	7.37 μv/LB	10.00 / 13	60 / 13	201 / 5	1K / 1	1688 LB	120	2.5V / +5.0 0.0	23K +IN TO GND	-	
14	LEFT LAP y LOAD	AAMRL/DYN 3D-SW	24Y	6.99 μv/LB	10.00 / 14	60 / 14	201 / 10	1K / 1	1779 LB	120	2.5V / +5.0 0.0	39K +IN TO GND	-	
15	LEFT LAP z LOAD	AAMRL/DYN 3D-SW	24Z	7.85 μv/LB	10.00 / 15	60 / 15	201 / 11	1K / 1	1584 LB	120	2.5V / +5.0 0.0	46K +IN TO GND	-	
16	RIGHT LAP x LOAD	AAMRL/DYN 3D-SW	15X	5.34 μv/LB	10.00 / 16	60 / 16	201 / 15	1K / 1	1873 LB	120	2.5V / +5.0 0.0	16.7K -IN TO GND	-	

ADACS EXTERNAL DATA

TABLE A-2b: +Gz TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gz STUDY) DATES: 24-JAN-95 THRU 13-MAR-95

FACILITY VERTICAL DECELERATION TOWER RUN NUMBERS: 3318 - 3405

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
17	RIGHT LAP y LOAD	AAMRL/DYN 3D-SW	15Y	5.33 μv/LB	10.00 / 17	60 / 17	402 / 2	1K / 1	1167 LB	120	2.5V / +5.0 0.0	13K +IN TO GND	-	
18	RIGHT LAP z LOAD	AAMRL/DYN 3D-SW	15Z	6.26 μv/LB	10.00 / 18	60 / 18	201 / 16	1K / 1	1987 LB	120	2.5V / +5.0 0.0	-	-	
25	SHOULDER x LOAD	AAMRL/DYN 3D-SW	20Z	6.30 μv/LB	10.00 / 25	60 / 25	402 / 4	1K / 1	987 LB	120	2.5V / +5.0 0.0	59K +IN TO GND	-	
26	SHOULDER y LOAD	AAMRL/DYN 3D-SW	20Y	5.35 μv/LB	10.00 / 26	60 / 26	800 / 1	1K / 1	584 LB	120	2.5V / +5.0 0.0	34.6K +IN TO GND	-	
27	SHOULDER z LOAD	AAMRL/DYN 3D-SW	20X	4.87 μv/LB	10.00 / 27	60 / 27	402 / 9	1K / 1	1277 LB	120	2.5V / +5.0 0.0	59K +IN TO GND	-	
45	EVENT	-	-	1.0 VOLT	: / 45	1000 / 12	2.5 / 21	1K / 1	2.5 VOLT	2000	5.0V / +5.0 0.0	-	-	PATCHED VIA ANALOG CHANNEL 1
46	T = 0 PULSE	-	-	1.0 VOLT	: / 46	1000 / 3	1 / -	1K / 1	2.5 VOLT	2000	0.0V / +5.0 0.0	-	-	PATCHED VIA HIGH LEVEL BOARD PATCH
47	VELOCITY	GLOBE 22A672-2	4	0.0611 VOLT/FT/SEC	: / 47	30 / 1	1 / -	1K / 1	81.8 F/S	60	0.0V / +5.0 0.0	-	-	RAW SENS. = 0.1733 V/REV/SEC; (12IN/FT/4.46IN/REV)*.1733V/REV/SEC= 0.466 V/FT/SEC ATTEN @7.63 ∴ 0.466V/FT/SEC/7.63= 0.0611 V/FT/SEC

ADACS EXTERNAL DATA

TABLE A-2c: +Gz TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 3).

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS -Gx & +Gy STUDY) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
1	SLED x ACCEL.	ENDEVCO 2262A-200	FR42	4.233 mv/G	10.00 1	: -	10 -	1K -	59.1G	120	0.0V +2.5 -2.5	RCAL	-	
2	SLED y ACCEL.	ENTRAN EGE-72B-200	93C19-R07	2.422 mv/G	10.00 2	: -	35 -	1K -	29.5G	120	0.0V +2.5 -2.5	RCAL	-	
3	SLED z ACCEL.	ENTRAN EGE-72B-200	93C19-R02	2.247 mv/G	10.00 3	: -	37 -	1K -	30.1G	120	0.0V +2.5 -2.5	RCAL	-	
4	SEAT x ACCEL.	ENTRAN EGE-72B-200	93C19-R14	2.290 mv/G	10.00 4	: -	18 -	1K -	60.7G	120	0.0V +2.5 -2.5	RCAL	-	
5	SEAT y ACCEL.	ENDEVCO 7264-200	CF48H	2.906 mv/G	10.00 5	: -	29 -	1K -	29.7G	120	0.0V +2.5 -2.5	RCAL	1.5K	
6	SEAT z ACCEL.	ENDEVCO 7264-200	CC99H	3.023 mv/G	10.00 6	: -	28 -	1K -	29.5G	120	0.0V +2.5 -2.5	RCAL	1.5K	USE NEGATIVE SENSITIVITY WHEN USING CONTOURED SEAT(C), CELLS G THRU O
7	EXT. CHEST x ACCEL	ENTRAN EGE-72B-200	93C19-R11	2.255 mv/G	10.00 7	: -	11 -	1K -	100.8G	120	0.0V +2.5 -2.5	RCAL	-	
8	EXT. CHEST y ACCEL.	ENTRAN EGE-72B-200	93C19-R12	2.342 mv/G	10.00 8	: -	21 -	1K -	50.8G	120	0.0V +2.5 -2.5	RCAL	-	

EME EXTERNAL DATA

TABLE A-3a: +Gy & -Gx TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 4)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS -Gx & +Gy STUDY) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
9	EXT. CHEST z ACCEL.	ENTRAN EGE-72B-200	93C19-R13	2.369 mv/G	10.00 9	: -	11 -	1K -	95.9G	120	0.0V +2.5 -2.5	RCAL	-	
10	LEFT LAP x LOAD	AAMRL/DYN 3D-SW	21Z	6.09 μv/LB	10.00 10	: -	102 -	1K -	4025 LB	120	0.0V +2.5 -2.5	RCAL	-	TEST 5218 THRU 5221, GAIN @ 82, F.S. 5006 LB
11	LEFT LAP y LOAD	AAMRL/DYN 3D-SW	21Y	4.88 μv/LB	10.00 11	: -	256 -	1K -	2001 LB	120	0.0V +2.5 -2.5	RCAL	-	
12	LEFT LAP z LOAD	AAMRL/DYN 3D-SW	21X	5.12 μv/LB	10.00 12	: -	163 -	1K -	2996 LB	120	0.0V +2.5 -2.5	RCAL	-	
13	RIGHT LAP x LOAD	AAMRL/DYN 3D-SW	22Z	7.69 μv/LB	10.00 13	: -	65 -	1K -	5002 LB	120	0.0V +2.5 -2.5	RCAL	-	
14	RIGHT LAP y LOAD	AAMRL/DYN 3D-SW	22Y	7.01 μv/LB	10.00 14	: -	178 -	1K -	2004 LB	120	0.0V +2.5 -2.5	RCAL	-	
15	RIGHT LAP z LOAD	AAMRL/DYN 3D-SW	22X	6.75 μv/LB	10.00 15	: -	124 -	1K -	2987 LB	120	0.0V +2.5 -2.5	RCAL	-	
33	LEFT SHOULDER x LOAD	AAMRL/DYN 3D-SW	23Z	7.85 μv/LB	10.00 33	: -	64 -	1K -	4976 LB	120	0.0V +2.5 -2.5	40K (+RCAL) -IN TO GND	-	TESTS 5218 - 5280, CHANNEL 16

EME EXTERNAL DATA

TABLE A-3b: +Gy & -Gx TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 4)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS -Gx & +Gy STUDY) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
34	LEFT SHOULDER y LOAD	AAMRL/DYN 3D-SW	23Y	7.09 μv/LB	10.00 34	: -	176 -	1K -	2003 LB	120	0.0V +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 17
35	LEFT SHOULDER z LOAD	AAMRL/DYN 3D-SW	23X	6.85 μv/LB	10.00 35	: -	122 -	1K -	2992 LB	120	0.0V +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 18
36	RIGHT SHOULDER x LOAD	AAMRL/DYN 3D-SW	25Z	7.74 μv/LB	10.00 36	: -	65 -	1K -	4969 LB	120	0.0V +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 19
37	RIGHT SHOULDER y LOAD	AAMRL/DYN 3D-SW	25Y	7.19 μv/LB	10.00 37	: -	174 -	1K -	1998 LB	120	0.0V +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 20
38	RIGHT SHOULDER z LOAD	AAMRL/DYN 3D-SW	25X	6.88 μv/LB	10.00 38	: -	121 -	1K -	3003 LB	120	0.0V +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 21
22	VELOCITY	GLOBE 22A672-2	2	0.02172 V/F/S	: -	: -	1 -	1K -	115.1 F/S	120	0.0V +2.5	-	-	RAW SENS. OF TACH = 0.1516 V/REV/SEC; 0.1766 V/F/S @ 10.3" CIR. WHEEL; ATTEN @ 8.13 ∴ 0.1766V/F/S/8.13= 0.0217 V/F/S
*33	SHOULDER x LOAD	AAMRL/DYN 3D-SW	23Z	7.85 μv/LB	10.00 33	: -	32 -	1K -	9952 LB	120	0.0V +2.5 -2.5	40K -IN TO GND +RCAL	-	TEST 5218 - 5280, CHANNEL 16
*34	SHOULDER y LOAD	AAMRL/DYN 3D-SD	23Y	7.09 μv/LB	10.00 34	: -	88 -	1K -	4007 LB	120	0.0V +2.5 -2.5	RCAL	-	TEST 5218 - 5280, CHANNEL 17

EME EXTERNAL DATA

* NOTE: USE LEFT SHOULDER LOAD TRANSDUCER FOR SINGLE HARNESS ATTACHMENT POINT (ALL CELLS EXCEPT A, F & J)

TABLE A-3c: +Gy & -Gx TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 4)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS -Gx & +Gy STUDY) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
*35	SHOULDER z LOAD	AAMRL/DYN 3D-SW	23X	6.85 µv/LB	10.00 / 35	: / -	61 / -	1K / -	5983 LB	120	0.0V / +2.5 -2.5	RCAL	-	TESTS 5218 - 5280, CHANNEL 18
24	LEFT KNEE FORCE	STRAINSERT FL2.5U-2SPKT	3294-2	7.98 µv/LB	10.00 / 24	: / -	313 / -	1K / -	1001 LB	120	0.0V / +2.5 -2.5	RCAL	-	CELL F ONLY
25	RIGHT KNEE FORCE	STRAINSERT FL2.5U-2SPKT	3294-3	7.99 µv/LB	10.00 / 25	: / -	313 / -	1K / -	1000 LB	120	0.0V / +2.5 -2.5	RCAL	-	CELL F ONLY
26	RIGHT HIP FORCE	STRAINSERT FL2.5U-2SPKT	3294-4	8.00 µv/LB	10.00 / 26	: / -	104 / -	1K / -	3005 LB	120	0.0V / +2.5 -2.5	RCAL	-	CELL F ONLY

EME EXTERNAL DATA

* NOTE: USE LEFT SHOULDER LOAD TRANSDUCER FOR SINGLE HARNESS ATTACHMENT POINT (ALL CELLS EXCEPT A, F & J)

TABLE A-3d: +Gy & -Gx TEST CONFIGURATION DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 4 OF 4)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-S MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
25	HEAD x ACCEL.	ENTRAN EGV3-F-250	94G30TB03 X	0.8867 mv/G	10.00 / 25	: / -	28.2 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	CHANNEL 1 THRU TEST 5220; 08-MAR-95
26	HEAD y ACCEL.	ENTRAN EGV3-F-250	94G30TB03 Y	-0.8813 mv/G	10.00 / 26	: / -	56.7 / -	1K / -	50G	120	0.0V / +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY; CHANNEL 2 THRU TEST 5220; 08-MAR-95
27	HEAD z ACCEL.	ENTRAN EGV3-F-250	94G30TB03 Z	0.8795 mv/G	10.00 / 27	: / -	28.4 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	CHANNEL 3 THRU TEST 5220; 08-MAR-95
29	CHEST x ACCEL.	ENTRAN EGV3-F-250	94G30TB04 X	-0.8816 mv/G	10.00 / 29	: / -	28.4 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY; CHANNEL 4 THRU TEST 5227; 08-MAR-95
5	CHEST y ACCEL.	ENTRAN EGV3-F-250	94G30TB04 Y	-0.8990 mv/G	10.00 / 5	: / -	55.6 / -	1K / -	50G	120	0.0V / +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
6	CHEST z ACCEL.	ENTRAN EGV3-F-250	94G30TB04 Z	0.8936 mv/G	10.00 / 6	: / -	28.0 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
7	PELVIS x ACCEL.	ENTRAN EGV3-F-250	93D22TF04 X	-1.014 mv/G	10.00 / 7	: / -	24.7 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY; HORIZONTAL IMPULSE ACCELERATOR TEST THRU 5329, S/N 94G30TB05 X, SENS. -0.8498, GAIN 29.4

VERTICAL DECELERATION TOWER TESTS: 3327-3353

HORIZONTAL IMPULSE ACCELERATOR TESTS: 5220-5227; 5250-5259; 5277-5280; 5286-5287; 5323-5328; 5330-5334; 5347-5350; 5352; & 5354-5355

TABLE A-4a: SMALL JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-8 MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
8	PELVIS y ACCEL.	ENTRAN EGV3-F-250	93D22TF04 Y	-1.085 mv/G	10.00 8	: -	46.1 -	1K -	50G	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY; HORIZONTAL IMPULSE ACCELERATOR TEST THRU 5329, S/N 94G30TB05 Y, SENS. -0.8696, GAIN 57.5
9	PELVIS z ACCEL.	ENTRAN EGV3-F-250	93D22TF04 Z	0.943 mv/G	10.00 9	: -	26.5 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	HORIZONTAL IMPULSE ACCELERATOR TEST THRU 5329, S/N 94G30TB05 Z, SENS. 0.8565, GAIN 29.2
10	NECK x FORCE	DENTON 1716	554 FX	-8.140 µv/LB	10.00 10	: -	307.1 -	1K -	1000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
11	NECK y FORCE	DENTON 1716	554 FY	-8.52 µv/LB	10.00 11	: -	586.9 -	1K -	500 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
12	NECK z FORCE	DENTON 1716	554 FZ	-4.03 µv/LB	10.00 12	: -	620.3 -	1K -	1000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
13	NECK Mx TORQUE	DENTON 1716	554 MX	6.81 µv/IN-LB	10.00 13	: -	367.1 -	1K -	1000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
14	NECK My TORQUE	DENTON 1716	554 MY	6.76 µv/IN-LB	10 14	: -	184.9 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
15	NECK Mz TORQUE	DENTON 1716	554 MZ	9.20 µv/IN-LB	10.00 15	: -	271.7 -	1K -	1000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	

TABLE A-4b: SMALL JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-S MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
16	LUMBAR x FORCE	DENTON 1914	295 FX	-6.58 µv/LB	10.00 16	- -	126.6 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
17	LUMBAR y FORCE	DENTON 1914	295 FY	-6.58 µv/LB	10.00 17	- -	190 -	1K -	2000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
18	LUMBAR z FORCE	DENTON 1914	295 FZ	-2.44 µv/LB	10.00 18	- -	341.5 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
19	LUMBAR Mx TORQUE	DENTON 1914	295 MX	5.15 µv/IN-LB	10.00 19	- -	242.7 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
20	LUMBAR My TORQUE	DENTON 1914	295 MY	5.15 µv/IN-LB	10.00 20	- -	161.8 -	1K -	3000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
21	LUMBAR Mz TORQUE	DENTON 1914	295 MZ	8.33 µv/IN-LB	10.00 21	- -	150.1 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
22	CHEST DISPLACEMENT	-	-	17.88 mv/DEGREE	10 22	- -	1 -	1K -	140 DEGREES	120	- +2.5 -2.5	-	-	
23	EVENT	-	-	1 VOLT	- -	- -	1 -	1K -	2.5 VOLT	1K	5.0V +2.5 -2.5	-	-	5V TO 0V

TABLE A-4c: SMALL JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
25	HEAD x ACCEL.	ENTRAN EGV3-F-250	94G21TS02 X	0.8806 mv/G	10.00 25	: -	28.4 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	CHANNEL 1 THRU TEST 5227; 15-MAR-95
26	HEAD y ACCEL.	ENTRAN EGV3-F-250	94G21TS02 Y	-0.8562 mv/G	10.00 26	: -	58.4 -	1K -	50G	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY; CHANNEL 2 THRU TEST 5227; 15-MAR-95
27	HEAD z ACCEL.	ENTRAN EGV3-F-250	94G21TS02 Z	0.8869 mv/G	10.00 27	: -	28.2 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	CHANNEL 3 THRU TEST 5227; 15-MAR-95
29	CHEST x ACCEL.	ENTRAN EGV3-F-250	94G30TB01 X	0.8841 mv/G	10.00 29	: -	28.3 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	CHANNEL 4 THRU TEST 5227; 15-MAR-95
5	CHEST y ACCEL.	ENTRAN EGV3-F-250	94G30TB01 Y	0.8661 mv/G	10.00 5	: -	57.7 -	1K -	50G	120	0.0V +2.5 -2.5	RCAL	-	
6	CHEST z ACCEL.	ENTRAN EGV3-F-250	94G30TB01 Z	0.8763 mv/G	10.00 6	: -	28.5 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	
7	PELVIS x ACCEL	ENTRAN EGV3-F-250	94G21TS01 X	0.8813 mv/G	10.00 7	: -	28.4 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	

VERTICAL DECELERATION TOWER TESTS: 3354-3374

HORIZONTAL IMPULSE ACCELERATOR TESTS: 5218-5219; 5233-5244; 5263-5265; 5281-5285; 5312-5317; 5335; 5339-5343; & 5351

TABLE A-5a: LARGE JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
8	PELVIS y ACCEL.	ENTRAN EGV3-F-250	94G21TS01 Y	-0.8746 mv/G	10.00 8	: -	57.2 -	1K -	50G	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
9	PELVIS z ACCEL.	ENTRAN EGV3-F-250	94G21TS01 Z	0.8809 mv/G	10.00 9	: -	28.4 -	1K -	100G	120	0.0V +2.5 -2.5	RCAL	-	
10	NECK x FORCE	DENTON 1716	553 FX	-8.04 μv/LB	10.00 10	: -	310.0 -	1K -	1000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
11	NECK y FORCE	DENTON 1716	553 FY	-8.47 μv/LB	10.00 11	: -	590.0 -	1K -	500 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
12	NECK z FORCE	DENTON 1716	553 FZ	-3.99 μv/LB	10.00 12	: -	626 -	1K -	1000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
13	NECK Mx TORQUE	DENTON 1716	553 MX	6.62 μv/IN-LB	10.00 13	: -	377.6 -	1K -	1000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
14	NECK My TORQUE	DENTON 1716	553 MY	6.79 μv/IN-LB	10 14	: -	184.1 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
15	NECK Mz TORQUE	DENTON 1716	553 MZ	9.17 μv/IN-LB	10.00 15	: -	272.6 -	1K -	1000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	

TABLE A-5b: LARGE JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL JPAT-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
16	LUMBAR x FORCE	DENTON 1914	296 FX	-6.58 μv/LB	10.00 16	- -	126 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
17	LUMBAR y FORCE	DENTON 1914	296 FY	-6.60 μv/LB	10.00 17	- -	189 -	1K -	2000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
18	LUMBAR z FORCE	DENTON 1914	296 FZ	-2.43 μv/LB	10.00 18	- -	342 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
19	LUMBAR Mx TORQUE	DENTON 1914	296 MX	5.13 μv/IN-LB	10.00 19	- -	121.8 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	THRU HORIZONTAL IMPULSE ACCELERATOR TEST 5218, GAIN @ 243.7, 06-MAR-95
20	LUMBAR My TORQUE	DENTON 1914	296 MY	5.16 μv/IN-LB	10.00 20	- -	161.5 -	1K -	3000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
21	LUMBAR Mz TORQUE	DENTON 1914	296 MZ	8.13 μv/IN-LB	10.00 21	- -	153.8 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
22	CHEST DISPLACEMENT	-	-	25.22 mv/DEGREE	10 22	- -	1 -	1K -	99 DEGREES	120	- - -	-	-	
23	EVENT	-	-		- 23	- -	1 -	1K -	2.5	1K	2.5V - -	-	-	

TABLE A-5c: LARGE JPATS MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 3)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM: IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY: VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
10	HEAD x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P13	1.929 mv/G	10.00 / 10	: / -	25.9 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
28	HEAD y ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P09	1.823 mv/G	10.00 / 28	: / -	27.4 / -	1K / -	50G	120	0.0V / +2.5 -2.5	RCAL	-	
29	HEAD z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P11	1.944 mv/G	10.00 / 29	: / -	12.9 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
6	CHEST x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P04	1.874 mv/G	10.00 / 6	: / -	13.3 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
7	CHEST y ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P7	1.876 mv/G	10.00 / 7	: / -	26.6 / -	1K / -	50G	120	0.0V / +2.5 -2.5	RCAL	-	
8	CHEST z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P03	1.583 mv/G	10.00 / 8	: / -	15.8 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
55	PELVIS x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P10	1.864 mv/G	10.00 / 55	: / -	13.4 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	

VERTICAL DECELERATION TOWER TESTS: 3400-3405

HORIZONTAL IMPULSE ACCELERATOR TESTS: 5228-5232; 5245-5249; 5260-5262; 5266-5276; 5318-5322; 5336-5338; & 5344-5346

TABLE A-6a: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
56	PELVIS y ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P12	1.876 mv/G	10.00 / 56	: / -	26.7 / -	1K / -	50G	120	0.0V / +2.5 -2.5	RCAL	-	
57	PELVIS z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P19	1.881 mv/G	10.00 / 57	: / -	13.3 / -	1K / -	100G	120	0.0V / +2.5 -2.5	RCAL	-	
25	NECK x FORCE	DENTON 1716	469 FX	7.94 μv/LB	10.00 / 25	: / -	314.9 / -	1K / -	1000 LB	120	0.0V / +2.5 -2.5	RCAL	-	
26	NECK y FORCE	DENTON 1716	469 FY	8.17 μv/LB	10.00 / 26	: / -	612.0 / -	1K / -	500 LB	120	0.0V / +2.5 -2.5	RCAL	-	
27	NECK z FORCE	DENTON 1716	469 FZ	3.98 μv/LB	10.00 / 27	: / -	628.1 / -	1K / -	1000 LB	120	0.0V / +2.5 -2.5	RCAL	-	
30	NECK Mx TORQUE	DENTON 1716	469 MX	-6.66 μv/IN-LB	10.00 / 30	: / -	375.4 / -	1K / -	1000 IN-LB	120	0.0V / +2.5 -2.5	RCAL	-	
31	NECK My TORQUE	DENTON 1716	469 MY	6.64 μv/IN-LB	10 / 31	: / -	188.2 / -	1K / -	2000 IN-LB	120	0.0V / +2.5 -2.5	RCAL	-	
32	NECK Mz TORQUE	DENTON 1716	469 MZ	9.02 μv/IN-LB	10.00 / 32	: / -	277.2 / -	1K / -	1000 IN-LB	120	0.0V / +2.5 -2.5	RCAL	-	

TABLE A-6b: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
49	LUMBAR x FORCE	DENTON 1914	0250 FX	-6.45 μv/LB	10.00 49	: -	129.2 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	USE NEGATIVE SENSITIVITY
50	LUMBAR y FORCE	DENTON 1914	0250 FY	6.49 μv/LB	10.00 50	: -	192.6 -	1K -	2000 LB	120	0.0V +2.5 -2.5	RCAL	-	
51	LUMBAR z FORCE	DENTON 1914	0250 FZ	2.37 μv/LB	10.00 51	: -	351.6 -	1K -	3000 LB	120	0.0V +2.5 -2.5	RCAL	-	
52	LUMBAR Mx TORQUE	DENTON 1914	0250 MX	5.04 μv/IN-LB	10.00 52	: -	248.0 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
53	LUMBAR My TORQUE	DENTON 1914	0250 MY	5.00 μv/IN-LB	10.00 53	: -	166.7 -	1K -	3000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
54	LUMBAR Mz TORQUE	DENTON 1914	0250 MZ	8.32 μv/IN-LB	10.00 54	: -	150.2 -	1K -	2000 IN-LB	120	0.0V +2.5 -2.5	RCAL	-	
37	LUMBAR PITCH	-	-	3.813 mv/V/DEGREE	5.0 37	: -	3.8 -	1K -	± 35 DEGREES	120	- 0.0 +5.0	JCAL	-	
38	LUMBAR ROLL	-	-	5.436 mv/V/DEGREE	- 38	: -	4.5 -	1K -	± 20 DEGREES	120	- 0.0 +5.0	JCAL	-	

TABLE A-6c: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
4	RIGHT HIP FLEXION/ EXTENSION	-	-	-3.829 mv/V/DEGREE	5.00 4	- -	2.0 -	1K -	-100 + 25 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
20	LEFT HIP FLEXION/ EXTENSION	-	-	3.969 mv/V/DEGREE	5.00 20	- -	2.0 -	1K -	-100 + 25 DEGREES	120	- 0.0 +5.0	JCAL	-	
3	RIGHT HIP ABDUCT/ ADDUCT	-	-	-4.479 mv/V/DEGREE	5.00 3	- -	2.2 -	1K -	- 65 + 35 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
19	LEFT HIP ABDUCT/ ADDUCT	-	-	4.544 mv/V/DEGREE	5.00 19	- -	2.2 -	1K -	- 65 + 35 DEGREES	120	- 0.0 +5.0	JCAL	-	
5	RIGHT HIP MEDIAL/ LATERAL ROTATION	-	-	4.177 mv/V/DEGREE	5.00 5	- -	1.1 -	1K -	± 50 DEGREES	120	- 0.0 +5.0	JCAL	-	
21	LEFT HIP MEDIAL/ LATERAL ROTATION	-	-	-4.470 mv/V/DEGREE	5.00 21	- -	2.2 -	1K -	± 50 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
2	RIGHT KNEE FLEXION	-	-	4.248 mv/V/DEGREE	5.0 2	- -	1.7 -	1K -	- 40 +100 DEGREES	120	- 0.0 +5.0	JCAL	-	
18	LEFT KNEE FLEXION	-	-	4.086 mv/V/DEGREE	5.0 18	- -	1.7 -	1K -	- 40 +100 DEGREES	120	- 0.0 +5.0	JCAL	-	

TABLE A-6d: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 4 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM: IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY: VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
1	RIGHT KNEE MEDIAL/LATERAL ROTATION	-	-	4.471 mv/V/DEGREE	5.00 1	: -	2.5 -	1K -	- 50 + 40 DEGREES	120	- 0.0 +5.0	JCAL	-	
17	LEFT KNEE MEDIAL/LATERAL ROTATION	-	-	-4.630 mv/V/DEGREE	5.00 17	: -	2.3 -	1K -	- 50 + 40 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
12	RIGHT SHOULDER FLEXION/ EXTENSION	-	-	-4.038 mv/V/DEGREE	5.00 12	: -	1.0 -	1K -	- 70 +145 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
44	LEFT SHOULDER FLEXION/ EXTENSION	-	-	4.158 mv/V/DEGREE	5.00 44	: -	1.0 - -	1K -	- 70 +145 DEGREES	120	- 0.0 +5.0	JCAL	-	
11	RIGHT SHOULDER TRANSVERSE ABDUCT/ADDUCT	-	-	-4.079 mv/V/DEGREE	5.00 11	: -	1.2 -	1K -	- 55 +145 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
22	LEFT SHOULDER TRANSVERSE ABDUCT/ADDUCT	-	-	3.973 mv/V/DEGREE	5.00 22	: -	1.2 -	1K -	- 55 +145 DEGREES	120	- 0.0 +5.0	JCAL	-	
14	RIGHT SHOULDER CORONAL ABDUCT/ADDUCT	-	-	-4.126 mv/V/DEGREE	5.0 14	: -	1.0 -	1K -	- 70 +180 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
46	LEFT SHOULDER CORONAL ABDUCT/ADDUCT	-	-	4.212 mv/V/DEGREE	5.0 46	: -	1.0 -	1K -	- 70 +180 DEGREES	120	- 0.0 +5.0	JCAL	-	

TABLE A-6e: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS
(PAGE 5 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
13	RIGHT SHOULDER MEDIAL/LATERAL ROTATION	-	-	3.465 mv/V/DEGREE	5.00 13	: -	1.9 -	1K -	- 20 +130 DEGREES	120	- 0.0 +5.0	JCAL	-	
45	LEFT SHOULDER MEDIAL/LATERAL ROTATION	-	-	-3.058 mv/V/DEGREE	5.00 45	: -	2.2 -	1K -	- 20 +130 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
15	RIGHT ELBOW FLEXION	-	-	-4.307 mv/V/DEGREE	5.00 15	: -	1.4 -	1K -	-100 + 60 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
47	LEFT ELBOW FLEXION	-	-	-3.990 mv/V/DEGREE	5.00 47	: -	1.5 -	1K -	-100 + 60 DEGREES	120	- 0.0 +5.0	JCAL	-	USE NEGATIVE SENSITIVITY
16	RIGHT FOREARM SUPINATION/ PRONATION	-	-	3.730 mv/V/DEGREE	5.00 16	: -	1.4 -	1K -	-110 + 90 DEGREES	120	- 0.0 +5.0	JCAL	-	
41	LEFT FOREARM SUPINATION/ PRONATION	-	-	-3.459 mv/V/DEGREE	5.00 41	: -	1.5 -	1K -	-110 + 90 DEGREES	120	- 0.0 +5.0	JCAL	-	
9	EVENT	-	-	1 VOLT	10.00 9	: -	1 -	1K -	2.5 VOLT	120	- 0.0 +5.0	-	-	TEST 5218-5238 ON CHANNEL 61; 5239-5268 ON CHANNEL 62
33	RIGHT LEG TORQUE POS.	-	-	.000668 mv/V/LB	5.0 33	: -	482.9 -	1K -	-100 +3000 LBS	120	- 0.0 +5.0	JCAL	-	

TABLE A-6f: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 6 OF 7)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS STUDY)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
34	RIGHT LEG TORQUE NEG.	-	-	.000628 mv/V/LB	5.00 34	- -	513.7 -	1K -	- 100 +3000 LBS	120	- 0.0 +5.0	JCAL	-	
35	LEFT LEG TORQUE POS.	-	-	.000602 mv/V/LB	5.00 35	- -	535.8 -	1K -	- 100 +3000 LBS	120	- 0.0 +5.0	JCAL	-	
36	RIGHT LEG TORQUE POS.	-	-	.000657 mv/V/LB	5.00 36	- -	491.0 -	1K -	- 100 +3000 LBS	120	- 0.0 +5.0	JCAL	-	

TABLE A-6g: LARGE ADAM MANIKIN INTERNAL DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 7 OF 7)

MANUFACTURER	MODEL	RANGE	SENSITIVITY (mv)	RESONANCE FREQ (Hz)	FREQUENCY RESPONSE (Hz)	EXCITATION (Volt)	2 ARM or 4 ARM	ADDITIONAL NOTES
ENDEVCO	2262A-200	± 200 G	2.5/G	7000	0-2000	10	4 ARM	LINEAR ACCELEROMETER
ENDEVCO	2264-200	± 200 G	2.5/G	4700	0-1200	10	2 ARM	LINEAR ACCELEROMETER
ENDEVCO	7264-200	± 200 G	2.5/G	6000	0-1200	10	2 ARM	LINEAR ACCELEROMETER
ENTRAN	EGA-125F-100D	± 100 G	2.5/G	1500	0-450	15	4 ARM	LINEAR ACCELEROMETER 500 G OVERRANGE 0.7 DAMPING
ENTRAN	EGE-72B-200	± 200 G	2.5/G	6000	0-1000	10	4 ARM	LINEAR ACCELEROMETER X10 OVERRANGE 0.7 DAMPING
ENTRAN	EGV3-F-250	± 250 G	1.0/G	2400	0-1200	10	4 ARM	LINEAR TRIAXIAL ACCELEROMETER 10,000 G OVERRANGE 0.7 DAMPING 12 VOLT EXC. MAX.
STRAINSERT	FL2.5U-2SPKT	± 2500 LB	.008/LB	3600	0-2000	10	4 ARM	LOAD CELL 15 V MAX EXC. 5 K LB MAX. OVERRANGE
DENTON	1716	± 3000 LB	-	N/A	N/A	10	4 ARM	6 AXIS LOAD CELL; 15 V MAX EXC.
DENTON	1914	± 3,000 LB	-	N/A	N/A	10	4 ARM	6 AXIS LOAD CELL; 15 V MAX EXC.

TABLE A-7: TYPICAL TRANSDUCER SPECIFICATIONS

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gz STUDY)   DATES: 24-JAN-95 THRU 13-MAR-95

FACILITY VERTICAL DECELERATION TOWER   RUN NUMBERS: 3318 - 3405

DATA POINT	TRANSDUCER	SERIAL	PRE - CAL		POST - CAL		%CHANGE	NOTES
	MFG. & MODEL	NUMBER	DATE	SENS	DATE	SENS		
CARRIAGE x ACCEL.	ENDEVCO 2264-200	CB09	13-JAN-95	2.957 mv/G	22-MAR-95	2.954 mv/G	-0.1	
CARRIAGE y ACCEL	ENDEVCO 2264-200	BN36	13-JAN-95	3.282 mv/G	22-MAR-95	3.273 mv/G	-0.3	
CARRIAGE z ACCEL.	ENDEVCO 2262A-200	FR31	10-JAN-95	5.14 mv/G	22-MAR-95	3.302 mv/G	+0.2	
SEAT x ACCEL.	ENDEVCO 2264-200	CH74	10-JAN-95	2.984 mv/G	30-MAR-95	2.987 mv/G	+0.1	
SEAT y ACCEL.	ENDEVCO 7264-200	CC79H	10-JAN-95	3.296 mv/G	30-MAR-95	3.302 mv/G	+0.2	
SEAT z ACCEL.	ENDEVCO 7264-200	CM11H	13-JAN-95	2.754 mv/G	30-MAR-95	2.759 mv/G	+0.2	TEST 3330 THRU 3405 ONLY
EXT. CHEST x ACCEL.	ENDEVCO 7264-200	BH76H	03-AUG-94	3.219 mv/G	30-MAR-95	3.220 mv/G	0	
EXT. CHEST y ACCEL.	ENDEVCO 7264-200	BH81H	03-AUG-94	3.265 mv/G	30-MAR-95	3.265 mv/G	0	
EXT. CHEST z ACCEL.	ENDEVCO 7264-200	BH87H	03-AUG-94	2.987 mv/G	30-MAR-95	2.985 mv/G	-0.1	
LEFT SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	7588-3	09-OCT-94	8.00 µv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
RIGHT SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	7135-4	24-JUN-94	7.96 µv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
CENTER SEAT PAN z LOAD	STRAINSERT FL2.5U-2SPKT	3294-6	20-OCT-94	7.96 µv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
LEFT LAP x LOAD	AAMRL/DYN 3D-SW	24X	12-JAN-95	7.37 µv/LB	03-MAY-95	7.36 µv/LB	-0.1	
LEFT LAP y LOAD	AAMRL/DYN 3D-SW	24Y	12-JAN-95	6.99 µv/LB	03-MAY-95	7.01 µv/LB	+0.3	

ADACS EXTERNAL DATA

TABLE A-8a: +Gz TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 2)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gz STUDY) DATES: 24-JAN-95 THRU 13-MAR-95

FACILITY VERTICAL DECELERATION TOWER RUN NUMBERS: 3318 - 3405

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
LEFT LAP z LOAD	AAMRL/DYN 3D-SW	24Z	12-JAN-95	7.85 µv/LB	03-MAY-95	7.86 µv/LB	+0.1	
RIGHT LAP x LOAD	AAMRL/DYN 3D-SW	15X	12-JAN-95	5.34 µv/LB	03-MAY-95	5.37 µv/LB	+0.6	
RIGHT LAP y LOAD	AAMRL/DYN 3D-SW	15Y	12-JAN-95	5.33 µv/LB	03-MAY-95	5.37 µv/LB	+0.8	
RIGHT LAP z LOAD	AAMRL/DYN 3D-SW	15Z	12-JAN-95	6.26 µv/LB	03-MAY-95	6.26 µv/LB	0	
SHOULDER x LOAD	AAMRL/DYN 3D-SW	20Z	12-JAN-95	6.30 µv/LB	04-MAY-95	6.32 µv/LB	+0.3	
SHOULDER y LOAD	AAMRL/DYN 3D-SW	20Y	12-JAN-95	5.35 µv/LB	04-MAY-95	5.35 µv/LB	0	
SHOULDER z LOAD	AAMRL/DYN 3D-SW	20X	12-JAN-95	4.87 µv/LB	04-MAY-95	4.91 µv/LB	+0.8	
VELOCITY	GLOBE 22A672-2	4	18-APR-94	0.0611 VOLT/FT/SEC	-	-	-	0.1733 V/REV/SEC RAW OUTPUT; (12IN/FT/4.46IN/REV)*.1733V/REV/SEC= 0.466 V/FT/SEC ATTEN @7.63 ∴ 0.466V/FT/SEC/7.63= 0.0611 V/FT/SEC CALIBRATED PERIODICALLY BY DYNCORP PERSONNEL
SEAT z ACCEL.	ENDEVCO 2264-200	BY77H	03-AUG-94	3.355 mv/G	30-MAR-95	3.355 mv/G	-0.1	

ADACS EXTERNAL DATA

TABLE A-8b: +Gz TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 2)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gy & -Gx Study) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
SLED x ACCEL.	ENDEVCO 2262A-200	FR42	22-DEC-94	4.233 mv/G	08-JUN-95	4.233 mv/G	+0.4	
SLED y ACCEL	ENTRAN EGE-72B-200	93C19-R07	22-DEC-94	2.422 mv/G	08-JUN-95	2.405 mv/G	-0.7	
SLED z ACCEL.	ENTRAN EGE-72B-200	93C19-R02	22-DEC-94	2.247 mv/G	08-JUN-95	2.243 mv/G	-0.2	
SEAT x ACCEL.	ENTRAN EGE-72B-200	93C19-R14	22-DEC-94	2.290 mv/G	08-JUN-95	2.278 mv/G	-0.5	
SEAT y ACCEL.	ENDEVCO 7264-200	CF48H	23-FEB-95	2.906 mv/G	08-JUN-95	2.910 mv/G	+0.1	
SEAT z ACCEL.	ENDEVCO 7264-200	CC99H	22-DEC-94	3.023 mv/G	08-JUN-95	3.016 mv/G	-0.2	
EXT. CHEST x ACCEL.	ENTRAN EGE-72B-200	93C19-R11	23-DEC-94	2.255 mv/G	08-JUN-95	2.233 mv/G	-1.0	
EXT. CHEST y ACCEL.	ENTRAN EGE-72B-200	93C19-R12	23-DEC-94	2.342 mv/G	08-JUN-95	2.327 mv/G	-0.6	
EXT. CHEST z ACCEL.	ENTRAN EGE-72B-200	93C19-R13	23-DEC-94	2.369 mv/G	08-JUN-95	2.352 mv/G	-0.7	
LEFT LAP x LOAD	AAMRL/DYN 3D-SW	21Z	29-DEC-94	6.09 μv/LB	02-JUN-95	6.24 μv/LB	+2.5	
LEFT LAP y LOAD	AAMRL/DYN 3D-SW	21Y	29-DEC-94	4.88 μv/LB	02-JUN-95	4.96 μv/LB	+1.6	
LEFT LAP z LOAD	AAMRL/DYN 3D-SW	21X	29-DEC-94	5.12 μv/LB	02-JUN-95	5.21 μv/LB	+1.8	
RIGHT LAP x LOAD	AAMRL/DYN 3D-SW	22Z	05-APR-94	7.69 μv/LB	06-JUN-95	7.77 μv/LB	+1.0	
RIGHT LAP y LOAD	AAMRL/DYN 3D-SW	22Y	05-APR-94	7.01 μv/LB	06-JUN-95	7.09 μv/LB	+1.1	

EME EXTERNAL DATA

TABLE A-9a: +Gy AND -Gx TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 2)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS +Gy & -Gx Study) DATES: 06-MAR-95 THRU 30-MAY-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
RIGHT LAP z LOAD	AAMRL/DYN 3D-SW	22X	05-APR-94	6.75 μv/LB	06-JUN-95	6.84 μv/LB	+1.3	
LEFT SHOULDER x LOAD	AAMRL/DYN 3D-SW	23Z	29-DEC-94	7.85 μv/LB	06-JUN-95	7.97 μv/LB	+1.5	
LEFT SHOULDER y LOAD	AAMRL/DYN 3D-SW	23Y	29-DEC-94	7.09 μv/LB	06-JUN-95	7.22 μv/LB	+1.8	
LEFT SHOULDER z LOAD	AAMRL/DYN 3D-SW	23X	29-DEC-94	6.85 μv/LB	06-JUN-95	6.98 μv/LB	+1.9	
LEFT KNEE FORCE	STRAINSERT FL2.5U-2SPKT	3294-2	12-JAN-95	7.98 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
RIGHT KNEE FORCE	STRAINSERT FL2.5U-2SPKT	3294-3	09-JAN-95	7.99 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
RIGHT HIP FORCE	STRAINSERT FL2.5U-2SPKT	3294-4	12-JAN-95	8.00 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
VELOCITY	GLOBE 22A672-2	2	09-FEB-94	0.02172 V/F/S	-	-	-	0.1516 V/REV/SEC RAW OUTPUT; (12IN/FT/10.3IN/REV)*.1516V/REV/SEC= 0.1766 V/F/S ATTEN @8.130; ∴ 0.1766V/FT/S/8.130= 0.02172 V/F/S CALIBRATED PERIODICALLY BY DYNCORP PERSONNEL
RIGHT SHOULDER x LOAD	AAMRL/DYN 3D-SW	25Z	29-DEC-94	7.74 μv/LB	06-JUN-95	7.78 μv/LB	+0.5	
RIGHT SHOULDER y LOAD	AAMRL/DYN 3D-SW	25Y	29-DEC-94	7.19 μv/LB	06-JUN-95	7.26 μv/LB	+1.0	
RIGHT SHOULDER z LOAD	AAMRL/DYN 3D-SW	25X	29-DEC-94	6.88 μv/LB	06-JUN-95	6.94 μv/LB	+0.9	

EME EXTERNAL DATA

TABLE A-9b: +Gy AND -Gx TEST CONFIGURATION TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL JPAT-S MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
HEAD x ACCEL.	ENTRAN EGV3-F-250	94G30TB03X	09-JAN-95	0.8867 mv/G	-	-	-	ALL JPAT-S TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE.
HEAD y ACCEL	ENTRAN EGV3-F-250	94G30TB03Y	09-JAN-95	0.8813 mv/G	-	-	-	NO POST-CALIBRATION DATA AVAILABLE.
HEAD z ACCEL.	ENTRAN EGV3-F-250	94G30TB03Z	09-JAN-95	0.8795 mv/G	-	-	-	
CHEST x ACCEL.	ENTRAN EGV3-F-250	94G30TB04X	25-JAN-95	0.8816 mv/G	-	-	-	
CHEST y ACCEL.	ENTRAN EGV3-F-250	94G30TB04Y	25-JAN-95	0.8990 mv/G	-	-	-	
CHEST z ACCEL.	ENTRAN EGV3-F-250	94G30TB04Z	25-JAN-95	0.8936 mv/G	-	-	-	
PELVIS x ACCEL.	ENTRAN EGV3-F-250	94G30TB05X	09-JAN-95	0.8498 mv/G	-	-	-	TESTS THROUGH HIA 5230 ONLY
PELVIS y ACCEL.	ENTRAN EGV3-F-250	94G30TB05Y	09-JAN-95	0.8696 mv/G	-	-	-	TESTS THROUGH HIA 5230 ONLY
PELVIS z ACCEL.	ENTRAN EGV3-F-250	94G30TB05Z	09-JAN-95	0.8565 mv/G	-	-	-	TESTS THROUGH HIA 5230 ONLY
NECK x FORCE	DENTON 1716	554FX	29-NOV-94	8.140 µv/LB	-	-	-	
NECK y FORCE	DENTON 1716	554FY	29-NOV-94	8.52 µv/LB	-	-	-	
NECK z FORCE	DENTON 1716	554FZ	29-NOV-94	4.03 µv/LB	-	-	-	
NECK Mx TORQUE	DENTON 1716	554MX	29-NOV-94	6.81 µv/IN-LB	-	-	-	
NECK My TORQUE	DENTON 1716	554MY	29-NOV-94	6.76 µv/IN-LB	-	-	-	

TABLE A-10a: SMALL JPATS MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL JPAT-S MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER / HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 / 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
NECK Mz TORQUE	DENTON 1716	554MZ	29-NOV-94	9.20 μv/IN-LB	-	-	-	ALL JPAT-S TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE.
LUMBAR x FORCE	DENTON 1914	295FX	07-DEC-94	6.58 μv/LB	-	-	-	NO POST-CALIBRATION DATA AVAILABLE.
LUMBAR y FORCE	DENTON 1914	295FY	07-DEC-94	6.58 μv/LB	-	-	-	
LUMBAR z FORCE	DENTON 1914	295FZ	07-DEC-94	2.44 μv/LB	-	-	-	
LUMBAR Mx TORQUE	DENTON 1914	295MX	07-DEC-94	5.15 μv/IN-LB	-	-	-	
LUMBAR My TORQUE	DENTON 1914	295MY	07-DEC-94	5.15 μv/IN-LB	-	-	-	
LUMBAR Mz TORQUE	DENTON 1914	295MZ	07-DEC-94	8.33 μv/IN-LB	-	-	-	
PELVIS x ACCEL.	ENTRAN EGV3-F-250	93D22TF04X	13-APR-95	1.014 mv/G	-	-	-	HIA TESTS 5231 AND SUBSEQUENT ONLY
PELVIS y ACCEL.	ENTRAN EGV3-F-250	93D22TF04Y	13-APR-94	1.085 mv/G	-	-	-	HIA TESTS 5231 AND SUBSEQUENT ONLY
PELVIS z ACCEL.	ENTRAN EGV3-F-250	93D22TF04Z	13-APR-94	0.943 mv/G	-	-	-	HIA TESTS 5231 AND SUBSEQUENT ONLY

TABLE A-10b: SMALL JPATS MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL JPAT-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
HEAD x ACCEL.	ENTRAN EGV3-F-250	94G21TS02X	09-JAN-95	0.8806 mv/G	-	-	-	ALL JPAT-L TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE.
HEAD y ACCEL	ENTRAN EGV3-F-250	94G21TS02Y	09-JAN-95	0.8562 mv/G	-	-	-	NO POST-CALIBRATION DATA AVAILABLE.
HEAD z ACCEL.	ENTRAN EGV3-F-250	94G21TS02Z	09-JAN-95	0.8869 mv/G	-	-	-	
CHEST x ACCEL.	ENTRAN EGV3-F-250	94G30TB01X	09-JAN-95	0.8841 mv/G	-	-	-	
CHEST y ACCEL.	ENTRAN EGV3-F-250	94G30TB01Y	09-JAN-95	0.8661 mv/G	-	-	-	
CHEST z ACCEL.	ENTRAN EGV3-F-250	94G30TB01Z	09-JAN-95	0.8763 mv/G	-	-	-	
PELVIS x ACCEL.	ENTRAN EGV3-F-250	94G21TS01X	09-JAN-95	0.8813 mv/G	-	-	-	
PELVIS y ACCEL.	ENTRAN EGV3-F-250	94G21TS01Y	09-JAN-95	0.8746 mv/G	-	-	-	
PELVIS z ACCEL.	ENTRAN EGV3-F-250	94G21TS01Z	09-JAN-95	0.8809 mv/G	-	-	-	
NECK x FORCE	DENTON 1716	553FX	01-DEC-94	8.04 μv/LB	-	-	-	
NECK y FORCE	DENTON 1716	553FY	01-DEC-94	8.47 μv/LB	-	-	-	
NECK z FORCE	DENTON 1716	553FZ	01-DEC-94	3.99 μv/LB	-	-	-	
NECK Mx TORQUE	DENTON 1716	553MX	01-DEC-94	6.62 μv/IN-LB	-	-	-	
NECK My TORQUE	DENTON 1716	553MY	01-DEC-94	6.79 μv/IN-LB	-	-	-	

TABLE A-11a: LARGE JPATS MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL JPAT-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
NECK Mz TORQUE	DENTON 1716	553MZ	01-DEC-94	9.17 µv/IN-LB	-	-	-	ALL JPAT-L TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE.
LUMBAR x FORCE	DENTON 1914	296FX	08-DEC-94	6.58 µv/LB	-	-	-	NO POST-CALIBRATION DATA AVAILABLE.
LUMBAR y FORCE	DENTON 1914	296FY	08-DEC-94	6.60 µv/LB	-	-	-	
LUMBAR z FORCE	DENTON 1914	296FZ	08-DEC-94	2.43 µv/LB	-	-	-	
LUMBAR Mx TORQUE	DENTON 1914	296MX	08-DEC-94	5.13 µv/IN-LB	-	-	-	
LUMBAR My TORQUE	DENTON 1914	296MY	08-DEC-94	5.16 µv/IN-LB	-	-	-	
LUMBAR Mz TORQUE	DENTON 1914	296MZ	08-DEC-94	8.13 µv/IN-LB	-	-	-	

TABLE A-11b: LARGE JPATS MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study) DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
HEAD x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P13	02-FEB-95	1.929 mv/G	15-JUN-95	1.926 mv/G	-0.2	
HEAD y ACCEL	ENTRAN EGA-125F-100D	93F93F11-P09	02-FEB-95	1.823 mv/G	15-JUN-95	1.824 mv/G	+0.1	
HEAD z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P11	02-FEB-95	1.944 mv/G	15-JUN-95	1.953 mv/G	+0.5	
CHEST x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P04	02-FEB-95	1.874 mv/G	15-JUN-95	1.882 mv/G	+0.4	
CHEST y ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P07	02-FEB-95	1.876 mv/G	15-JUN-95	1.877 mv/G	+0.1	
CHEST z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P03	02-FEB-95	1.583 mv/G	15-JUN-95	1.596 mv/G	+0.8	
PELVIS x ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P10	02-FEB-95	1.864 mv/G	15-JUN-95	1.865 mv/G	+0.1	
PELVIS y ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P12	02-FEB-95	1.876 mv/G	15-JUN-95	1.879 mv/G	+0.2	
PELVIS z ACCEL.	ENTRAN EGA-125F-100D	93F93F11-P19	02-FEB-95	1.881 mv/G	15-JUN-95	1.867 mv/G	-0.7	
NECK x FORCE	DENTON 1716	469FX	03-FEB-95	7.94 μv/LB	-	-	-	ALL DENTON LOAD CELL TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE. NO POST-CALIBRATION DATA AVAILABLE.
NECK y FORCE	DENTON 1716	469FY	03-FEB-95	8.17 μv/LB	-	-	-	
NECK z FORCE	DENTON 1716	469FZ	03-FEB-95	3.98 μv/LB	-	-	-	
NECK Mx TORQUE	DENTON 1716	469MX	03-FEB-95	6.66 μv/IN-LB	-	-	-	
NECK My TORQUE	DENTON 1716	469MY	03-FEB-95	6.64 μv/IN-LB	-	-	-	

TABLE A-12a: LARGE ADAM MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 2)

DYNCORP PROGRAM CALIBRATION LOG
FOR INTERNAL ADAM-L MANIKIN TRANSDUCERS

PROGRAM IMPACT TESTING OF THE JPATS MANIKINS (JPATS Study)

DATES: 24-JAN-95 THRU 30-MAY-95

FACILITY VERTICAL DECELERATION TOWER HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 3318 - 3405 5218 - 5362

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
NECK Mz TORQUE	DENTON 1716	469MZ	03-FEB-95	9.02 μv/IN-LB	-	-	-	ALL DENTON LOAD CELL TRANSDUCERS ARE SRL'S RESPONSIBILITY TO CALIBRATE. NO POST-CALIBRATION DATA AVAILABLE.
LUMBAR x FORCE	DENTON 1914	0250FX	06-FEB-95	6.45 μv/LB	-	-	-	
LUMBAR y FORCE	DENTON 1914	0250FY	06-FEB-95	6.49 μv/LB	-	-	-	
LUMBAR z FORCE	DENTON 1914	0250FZ	06-FEB-95	2.37 μv/LB	-	-	-	
LUMBAR Mx TORQUE	DENTON 1914	0250MX	06-FEB-95	5.04 μv/IN-LB	-	-	-	
LUMBAR My TORQUE	DENTON 1914	0250MY	06-FEB-95	5.00 μv/IN-LB	-	-	-	
LUMBAR Mz TORQUE	DENTON 1914	0250MZ	06-FEB-95	8.32 μv/IN-LB	-	-	-	

TABLE A-12b: LARGE ADAM MANIKIN INTERNAL TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 2)

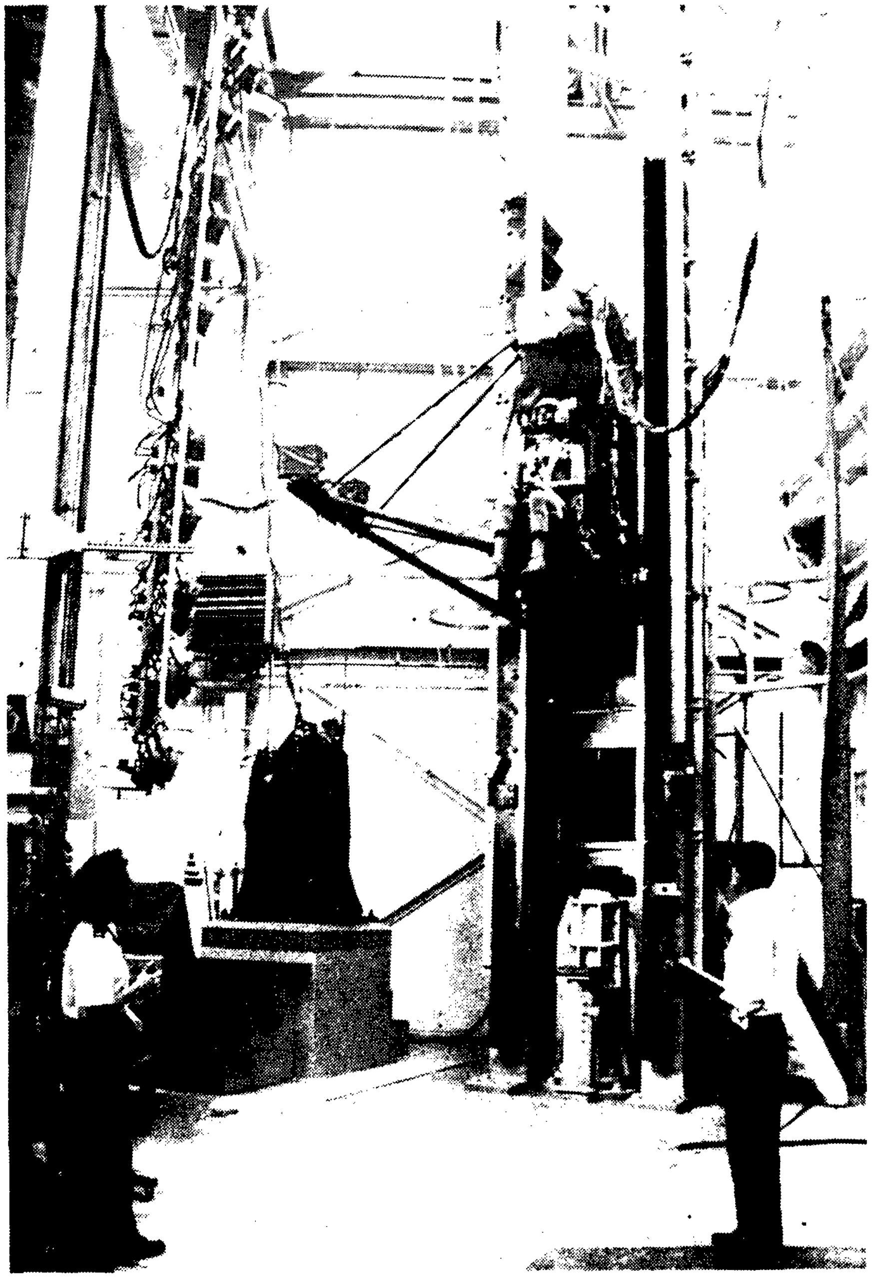


FIGURE A-1: AL/CFBE VERTICAL DECELERATION TOWER

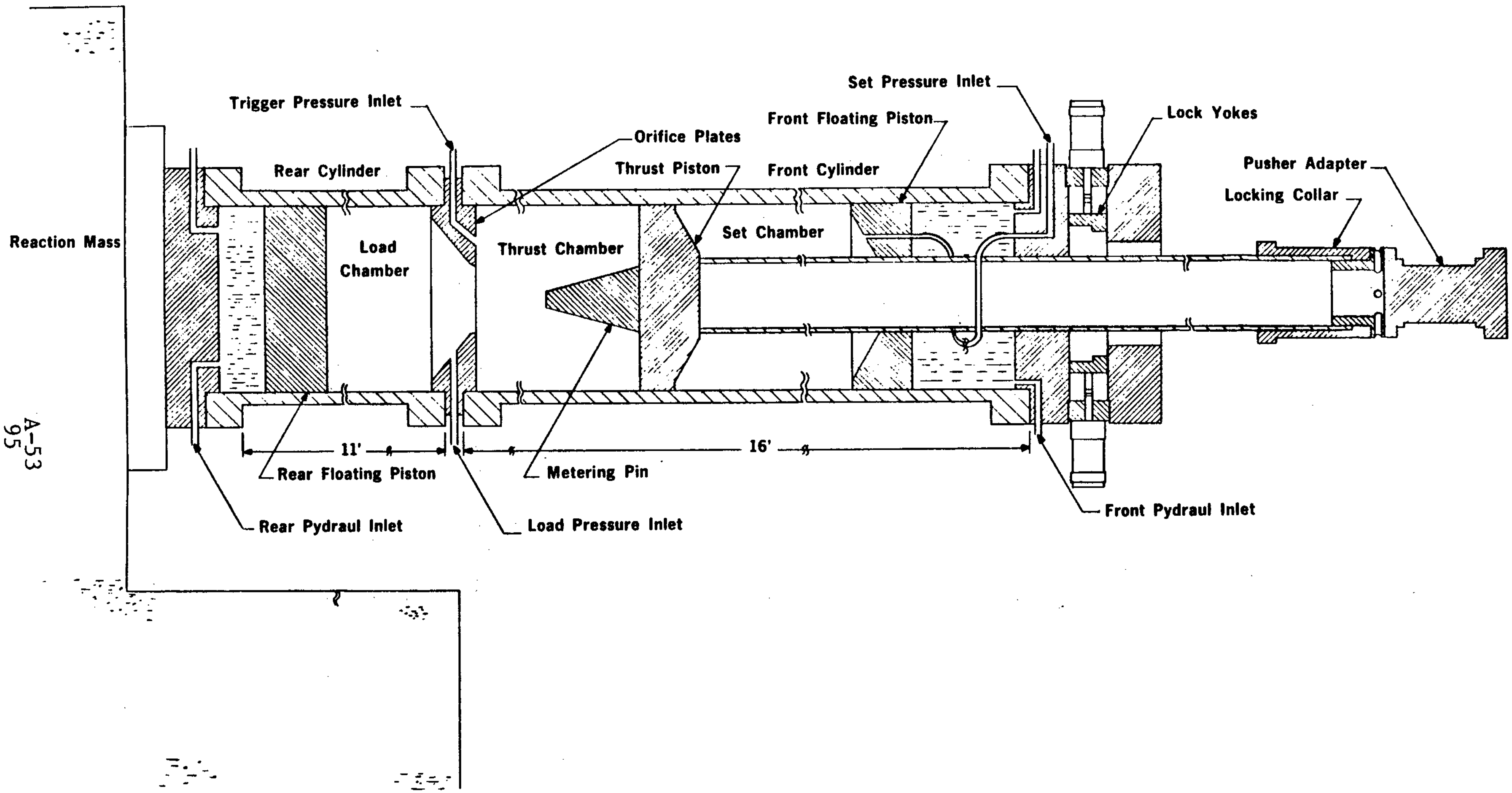


FIGURE A-2: HORIZONTAL IMPULSE ACCELERATOR ACTUATOR

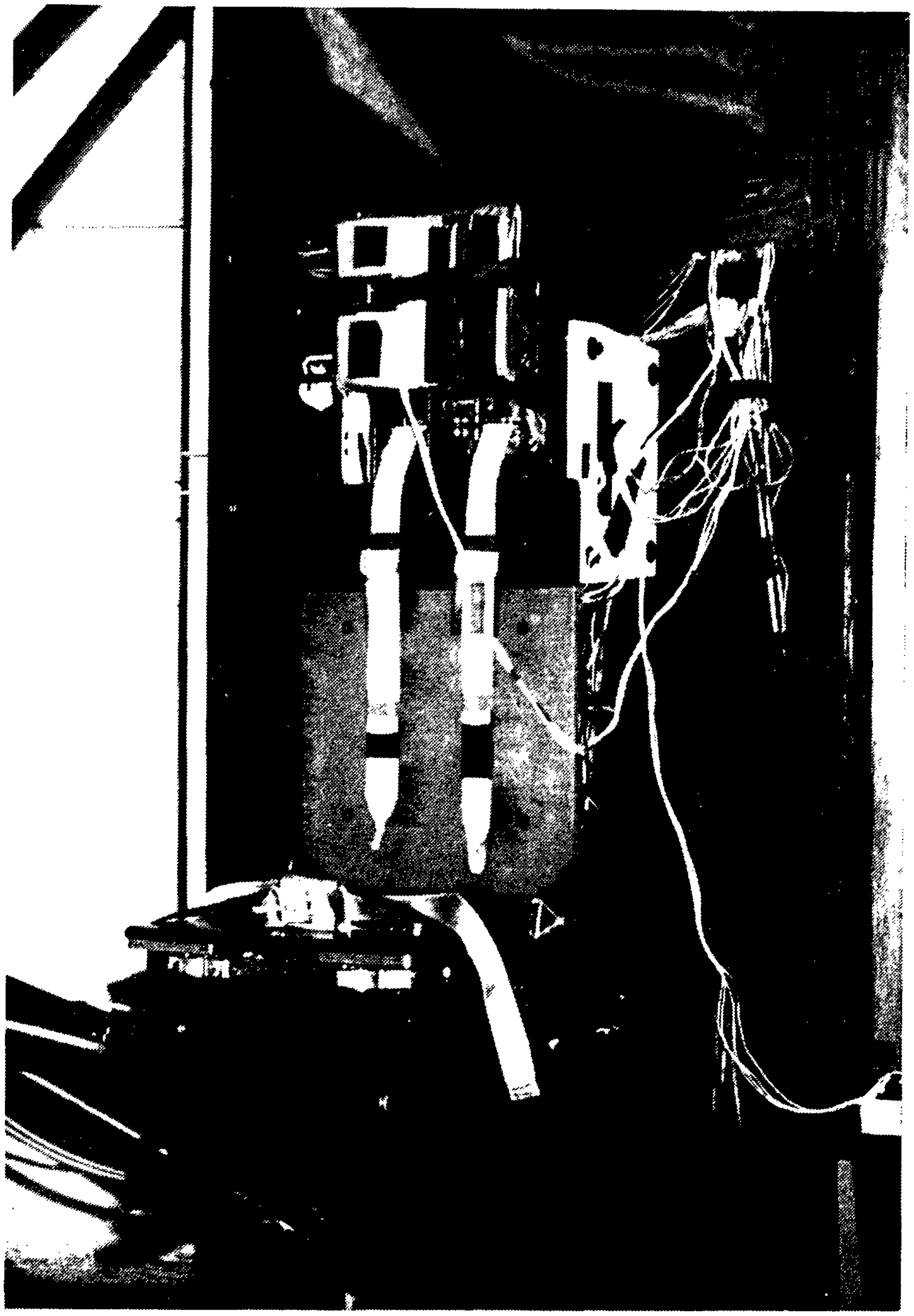


FIGURE A-3: +Gz SEAT CONFIGURATION (VIP SEAT FIXTURE)

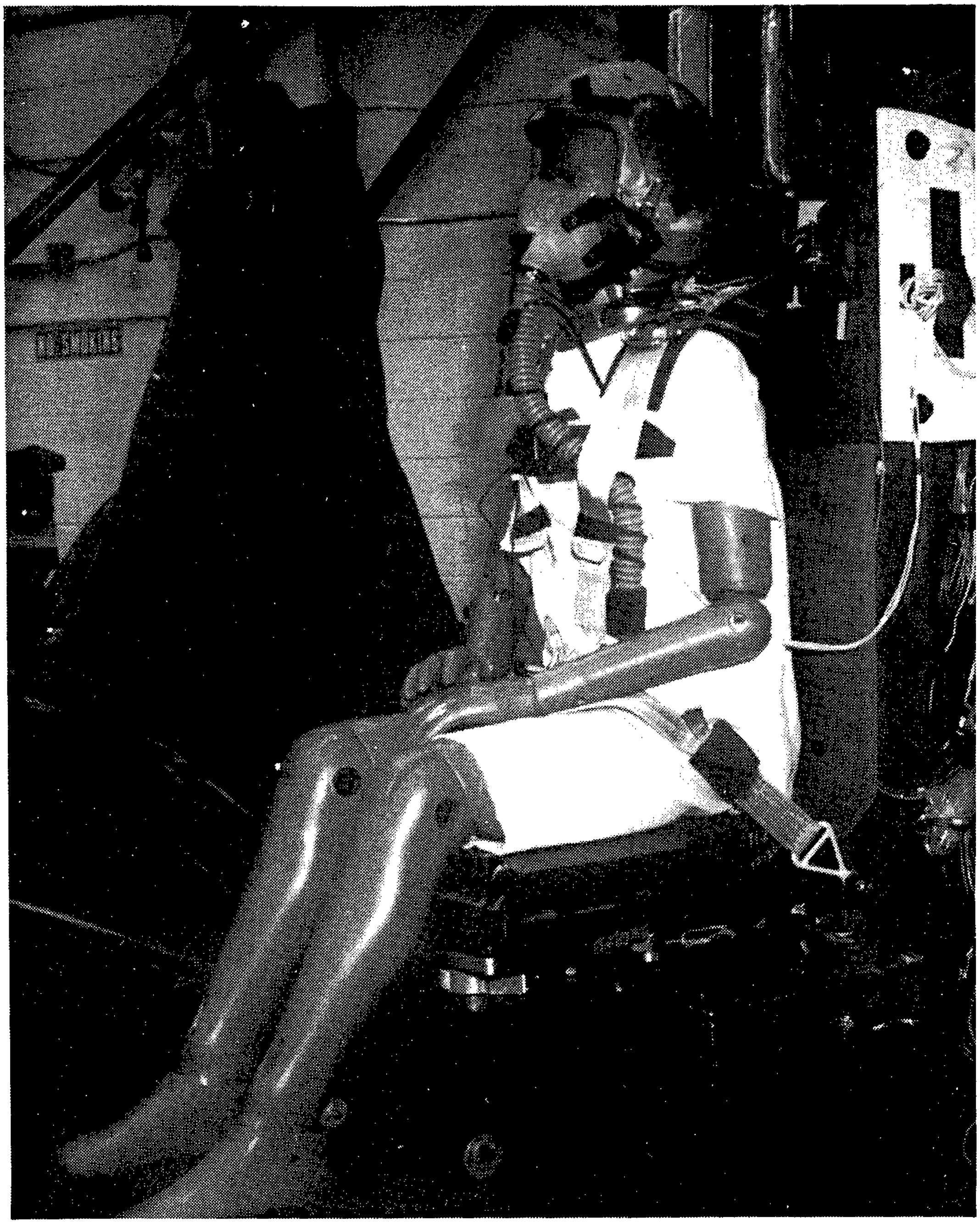


FIGURE A-4: +Gz TEST CONFIGURATION WITH SUBJECT'S LIMBS UNRESTRAINED

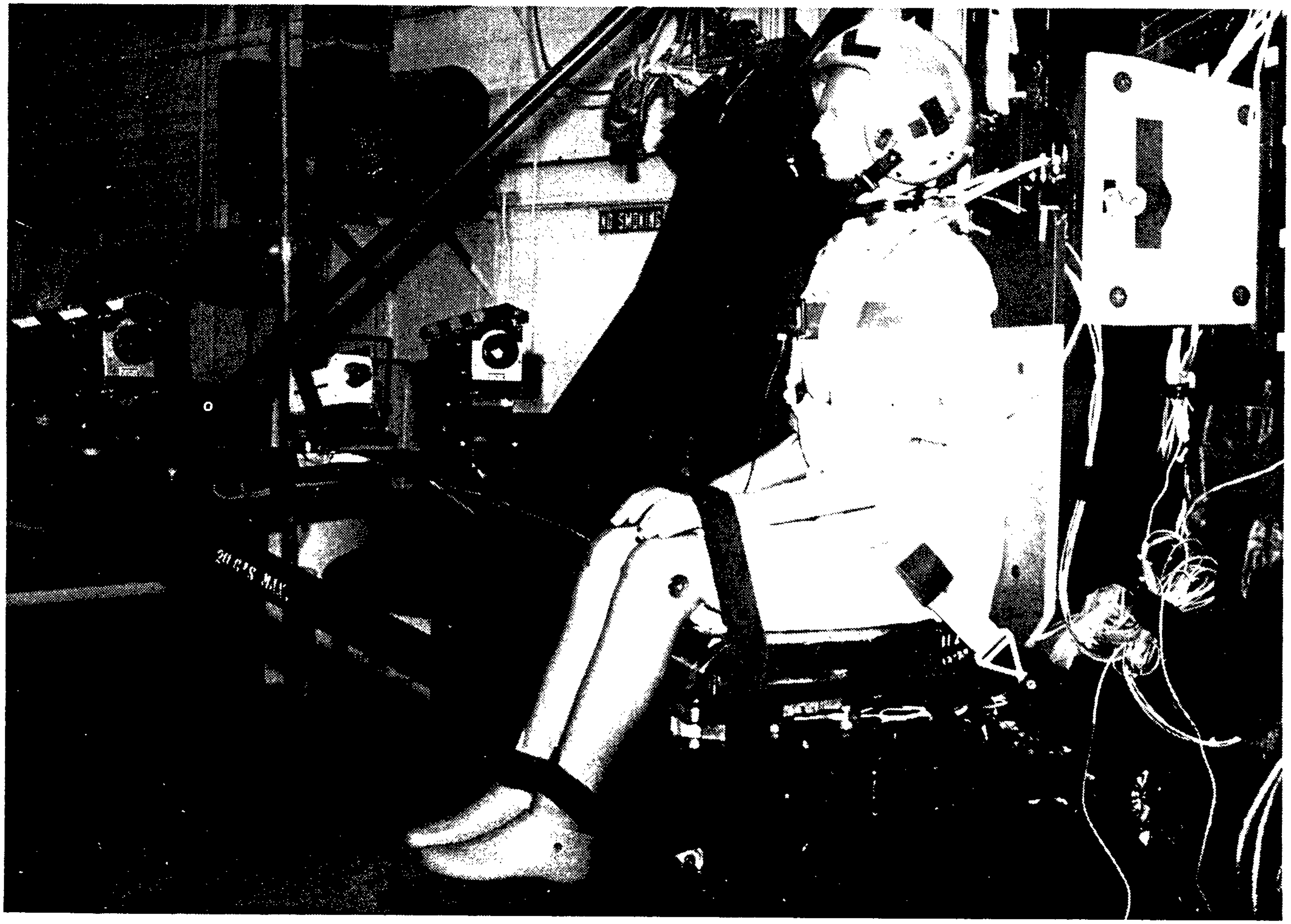


FIGURE A-5: +Gz TEST CONFIGURATION WITH SUBJECT'S LIMBS RESTRAINED

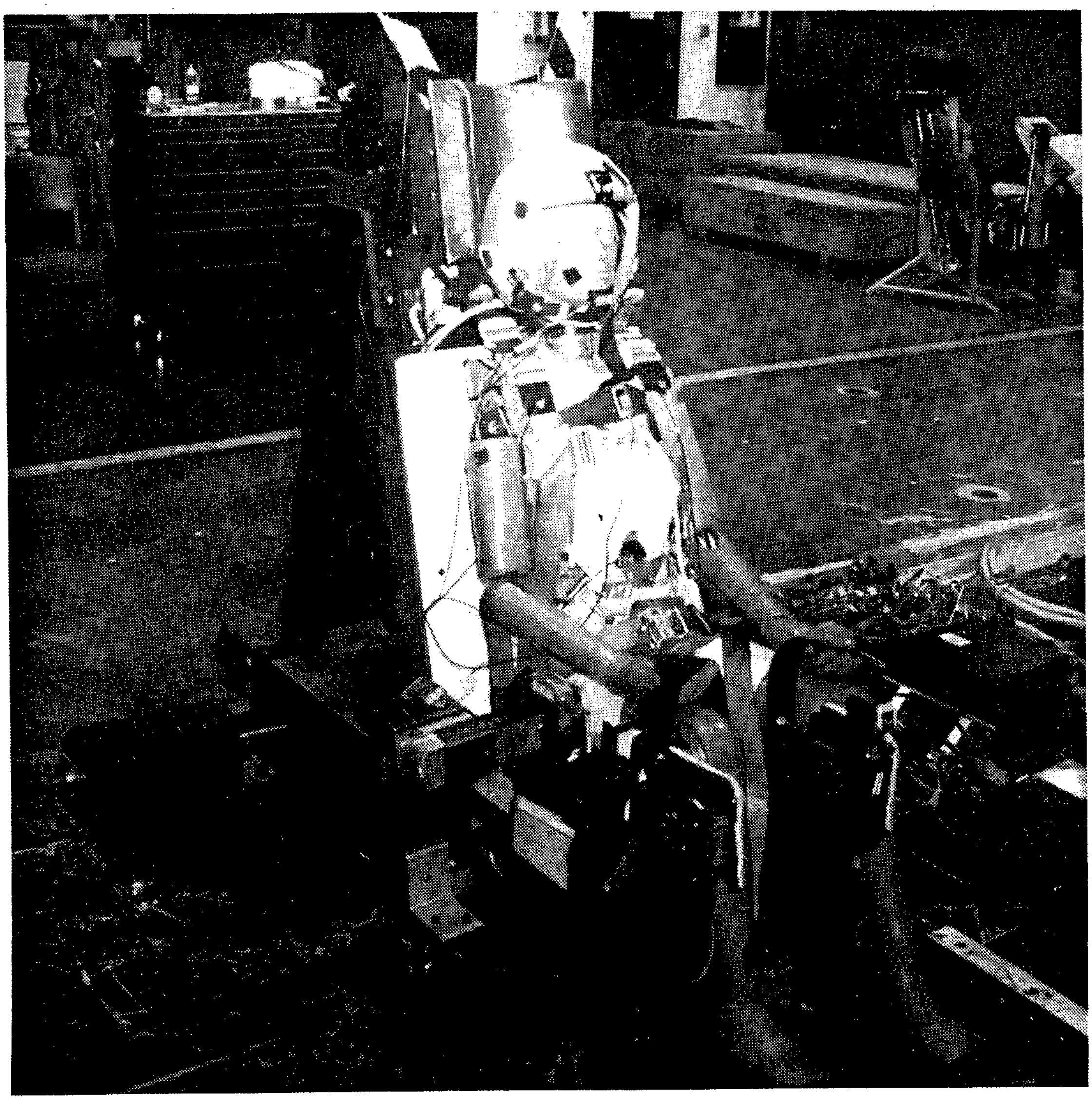


FIGURE A-6: +Gy TEST CONFIGURATION FOR CELL F TESTS

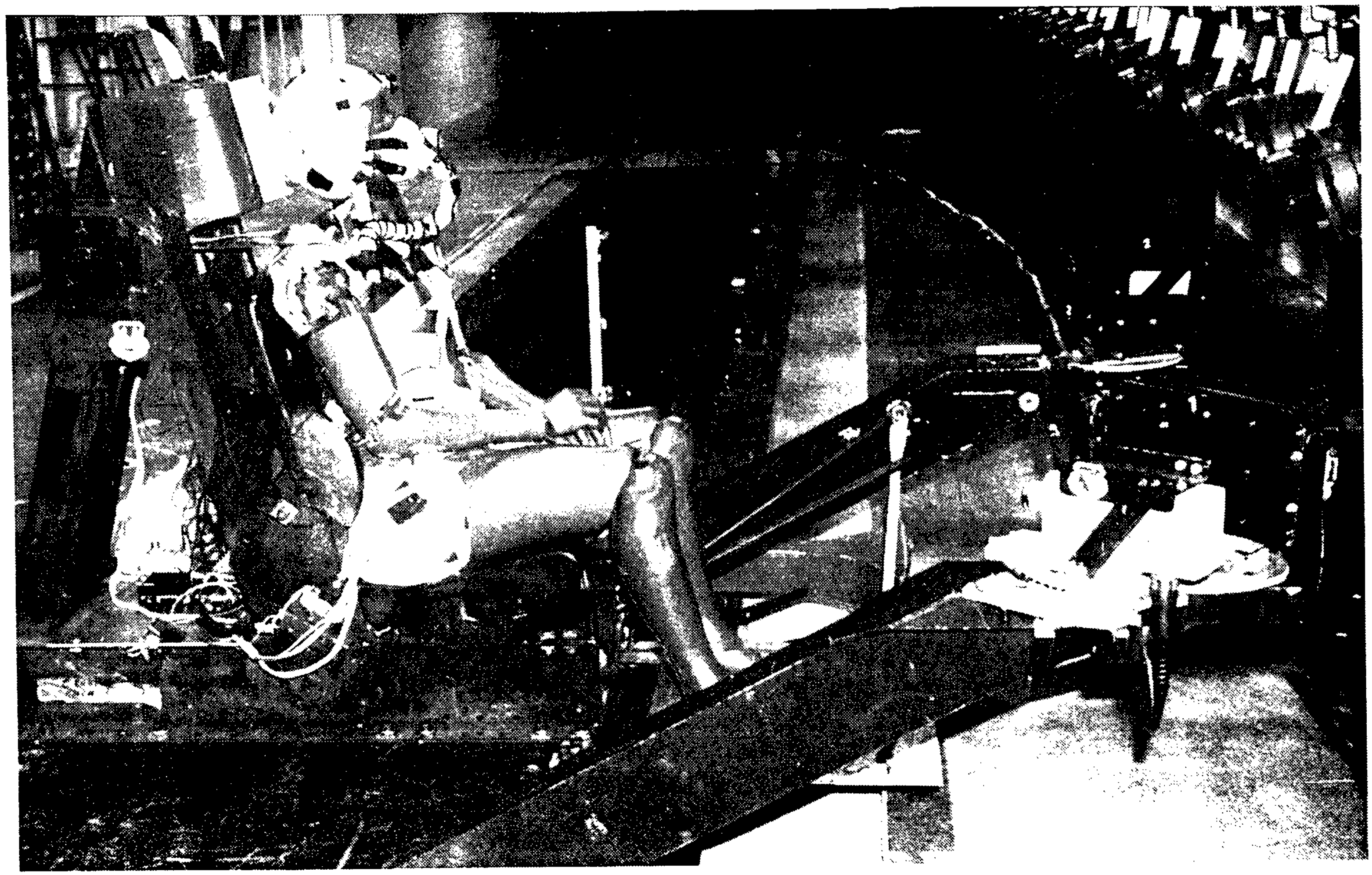


FIGURE A-7: +Gy TEST CONFIGURATION FOR CELL G AND G1 TESTS

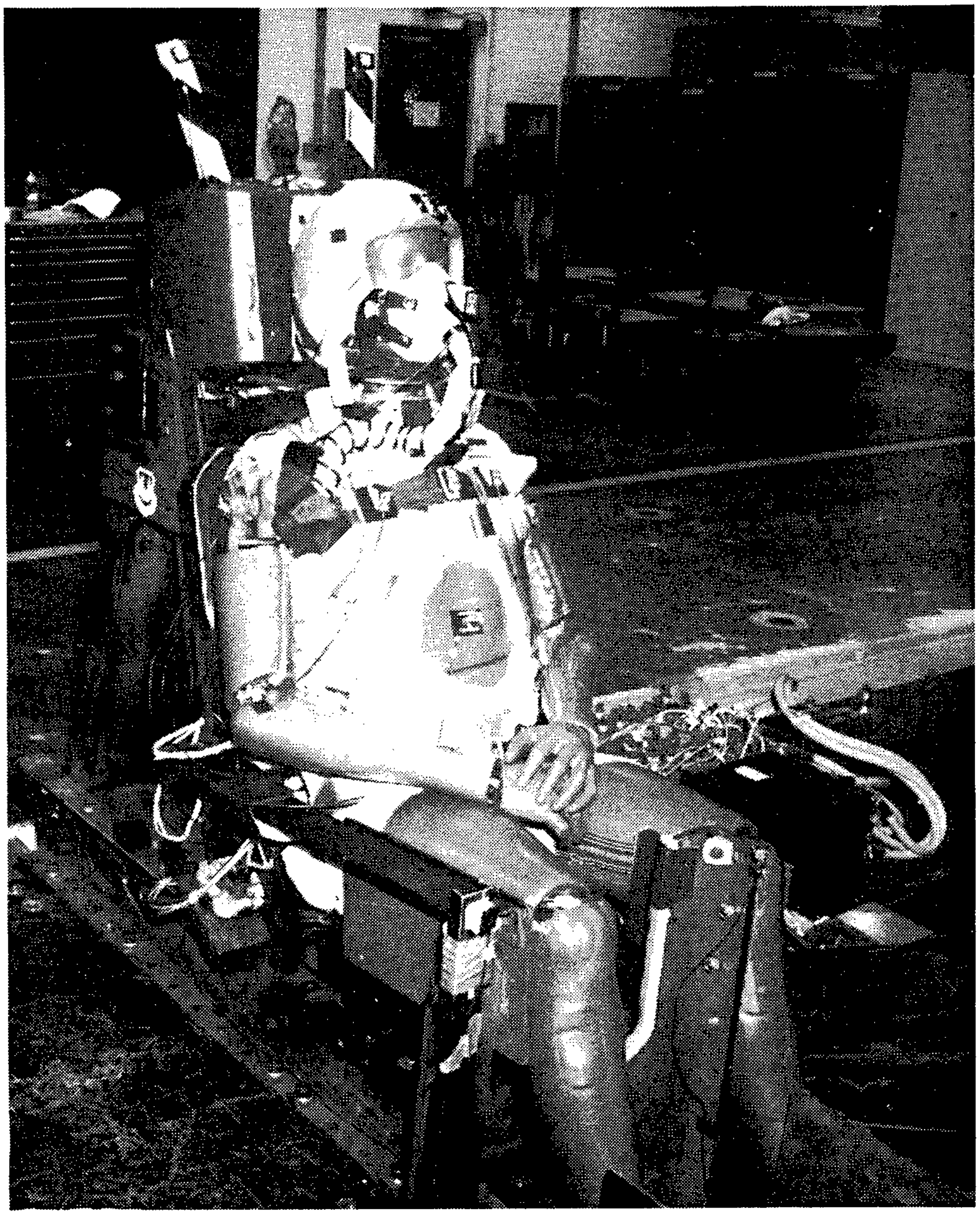


FIGURE A-8: +Gy TEST CONFIGURATION FOR CELL H AND I TESTS

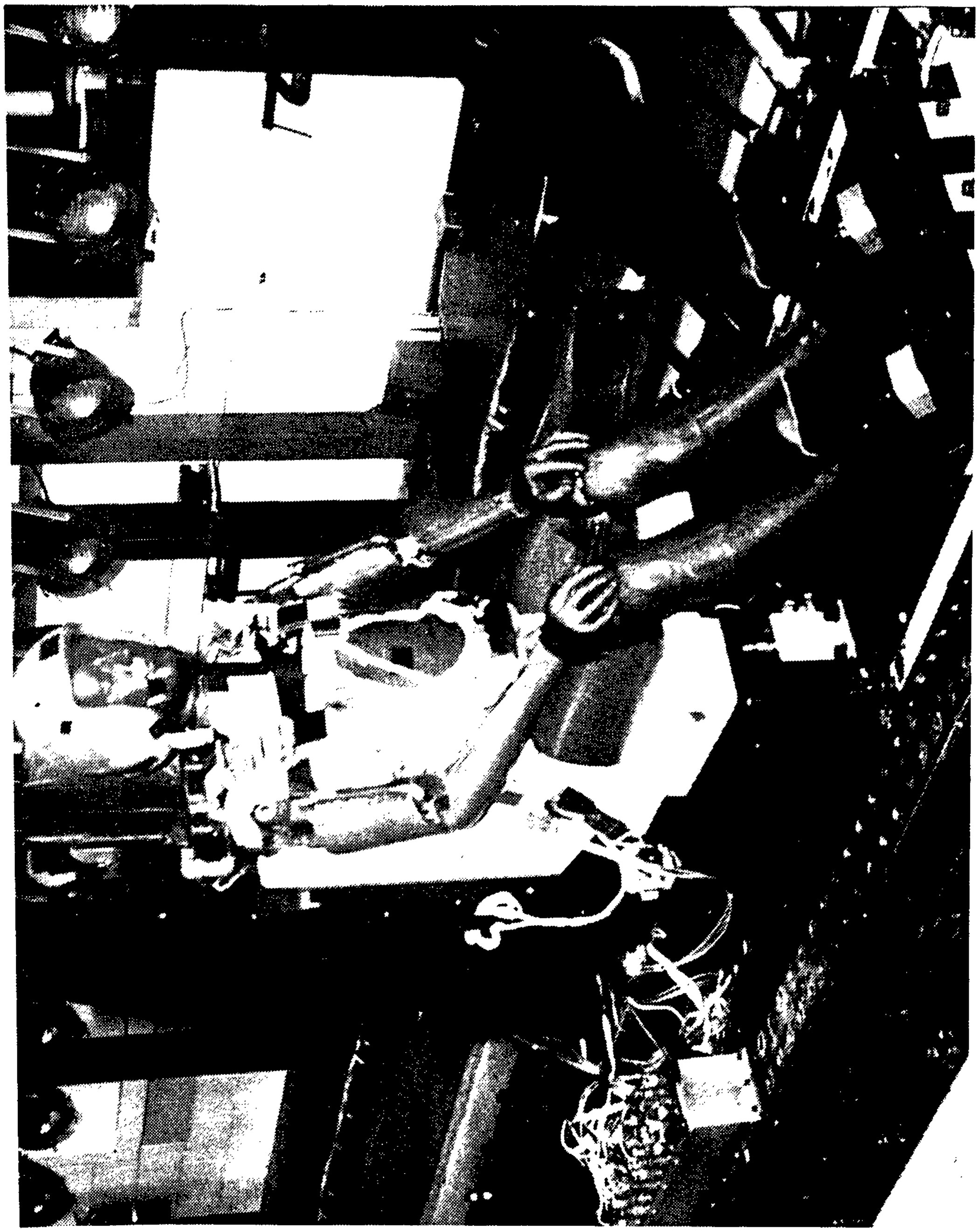


FIGURE A-9: -Gx TEST CONFIGURATION FOR CELL J TESTS

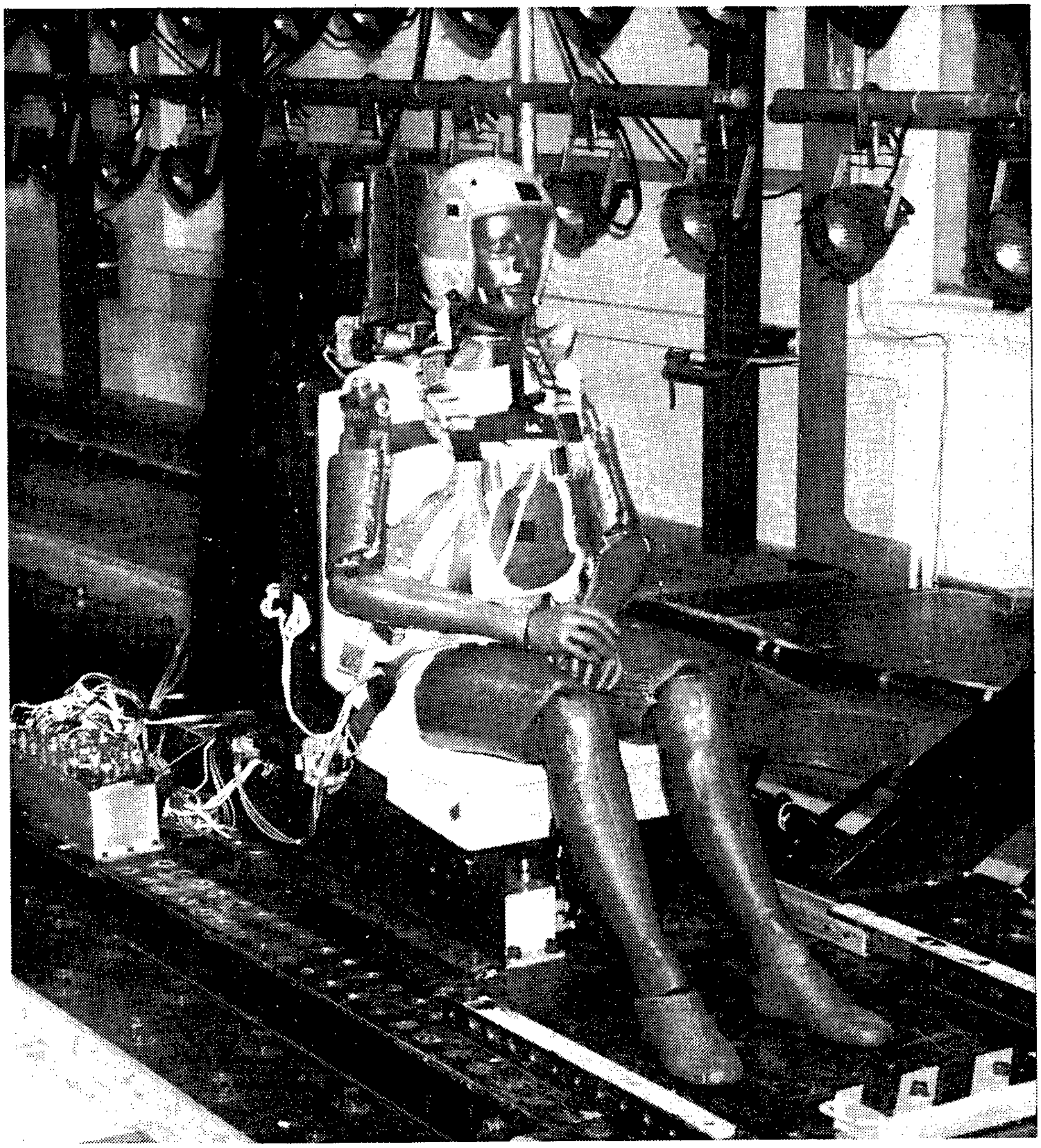


FIGURE A-10: -Gx TEST CONFIGURATION FOR CELL J1 TESTS

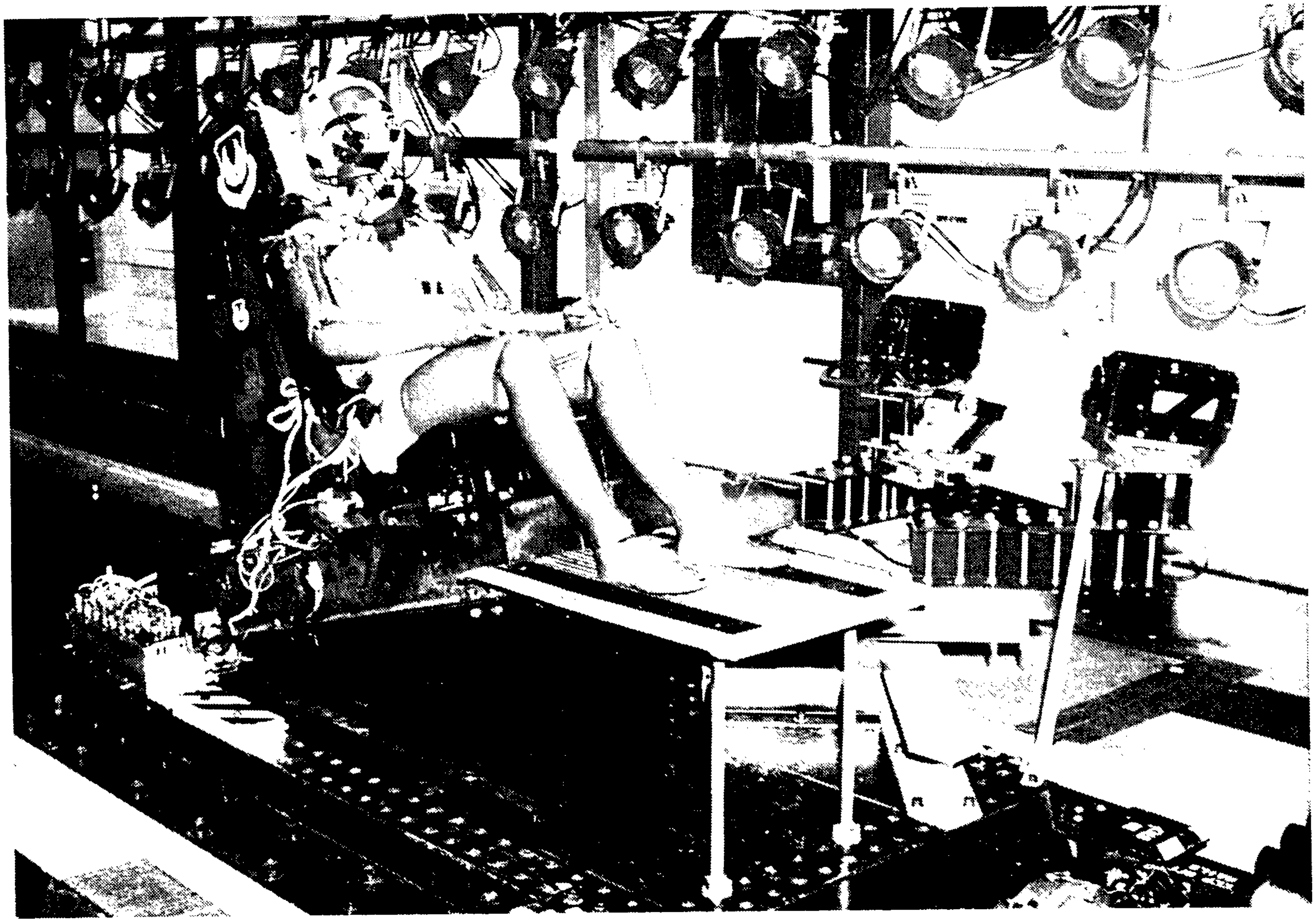
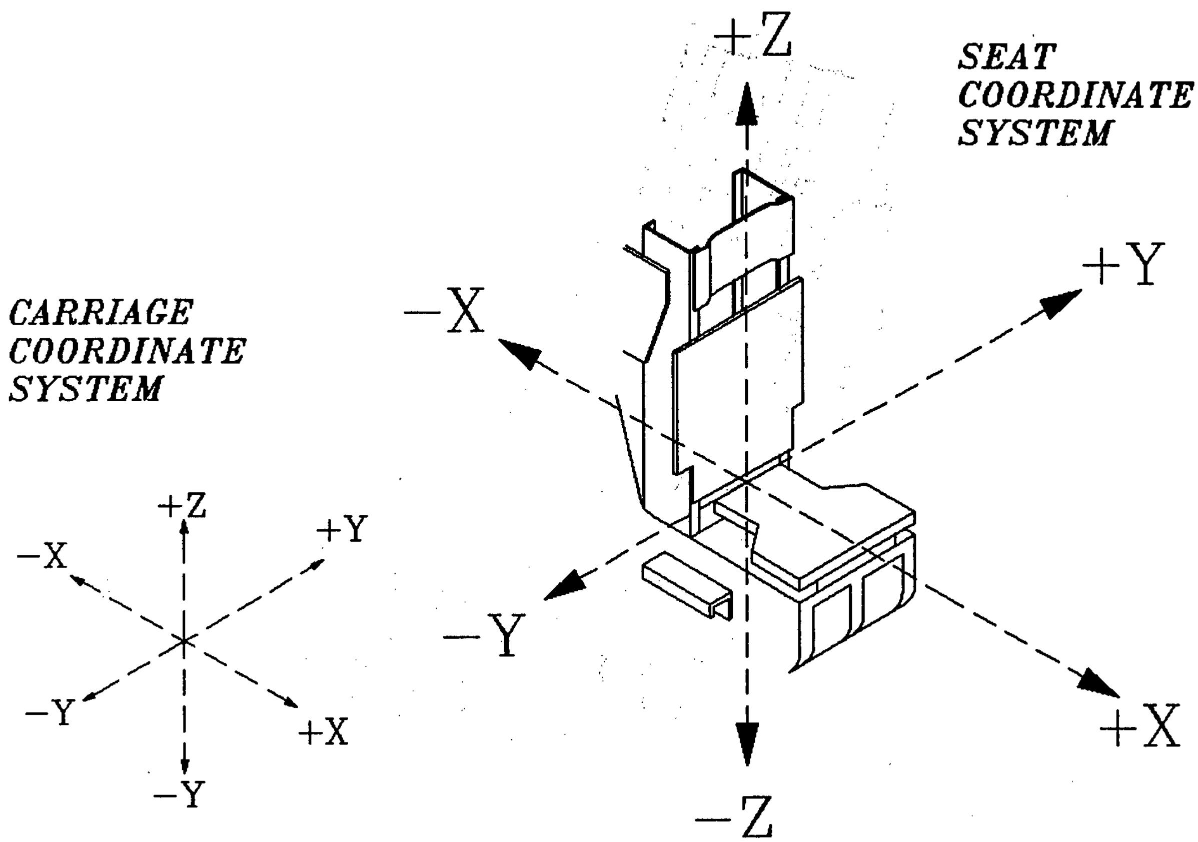


FIGURE A-11: -Gx TEST CONFIGURATION FOR CELL K THROUGH P TESTS

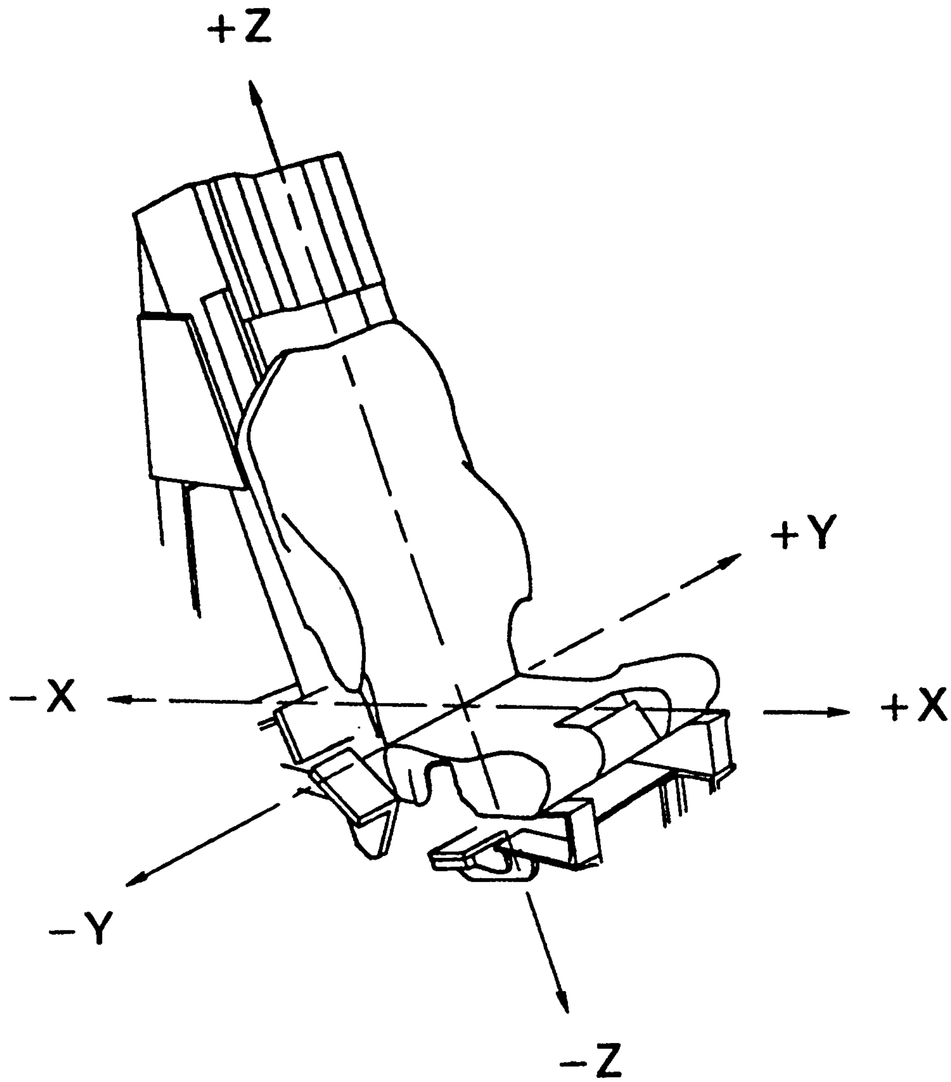


1. ALL TRANSDUCERS EXCEPT THE CARRIAGE ACCELEROMETERS AND THE CARRIAGE VELOCITY TACHOMETER WERE REFERENCED TO THE SEAT COORDINATE SYSTEM. THE CARRIAGE TACHOMETER WAS WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE DURING FREEFALL. THE CARRIAGE ACCELEROMETERS WERE REFERENCED TO THE CARRIAGE COORDINATE SYSTEM.

2. THE LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

3. THE LOAD CELLS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE FORCE EXERTED BY THE LOAD CELL ON THE SUBJECT WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

FIGURE A-12: AL/CFBE +Gz TEST CONFIGURATION COORDINATE SYSTEM

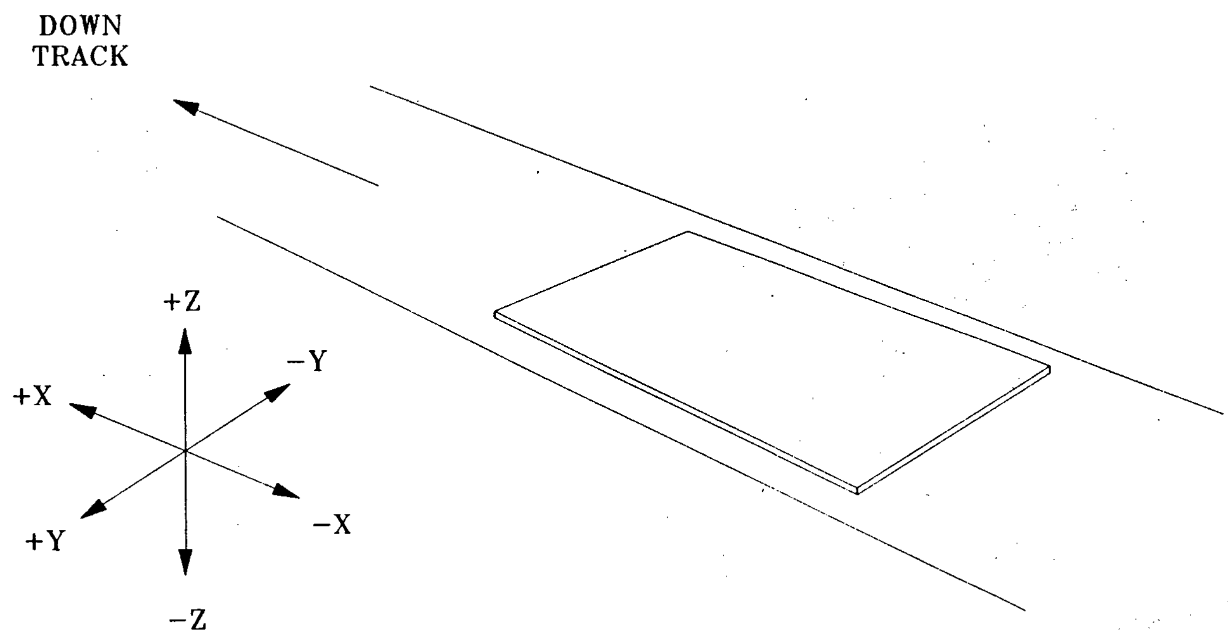


1. ALL TRANSDUCERS EXCEPT THE SLED ACCELEROMETERS AND THE SLED VELOCITY TACHOMETER WERE REFERENCED TO THE SEAT COORDINATE SYSTEM.

2. THE LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

4. THE LOAD CELLS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE FORCE EXERTED BY THE LOAD CELL ON THE SUBJECT WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

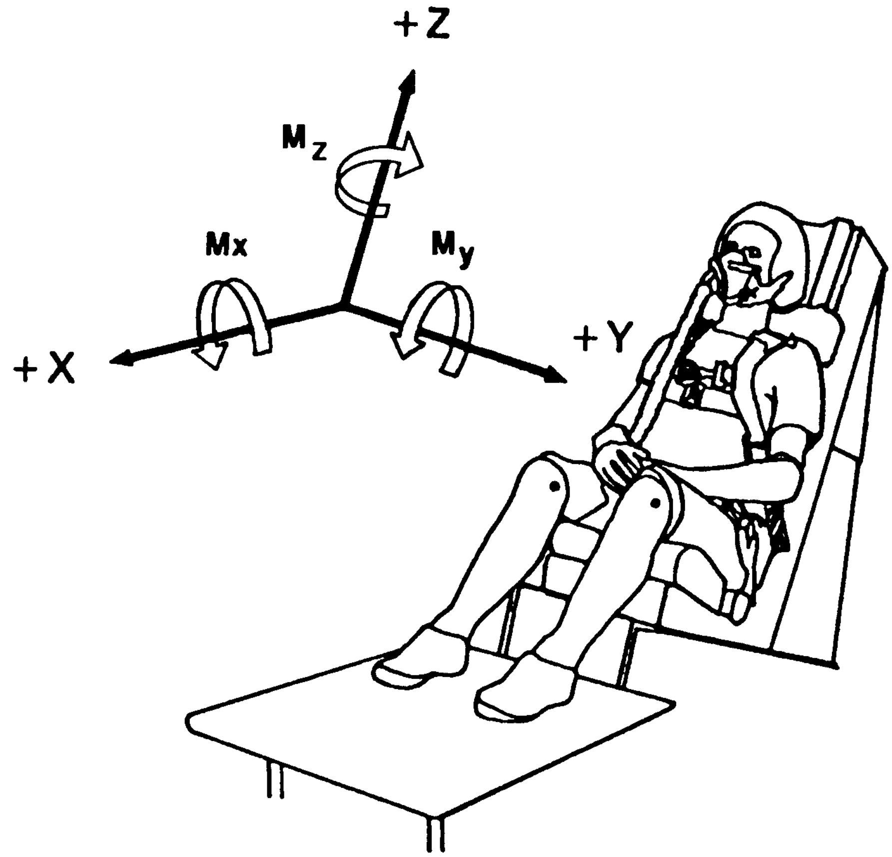
FIGURE A-13: AL/CFBE +Gy AND -Gx TEST CONFIGURATION COORDINATE SYSTEM



1. THE SLED LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER IS APPLIED IN THE +x, +y OR +z DIRECTIONS AS SHOWN.

2. THE SLED VELOCITY TACHOMETER WAS WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE SLED MOVES IN THE +x DIRECTION AS SHOWN.

FIGURE A-14: AL/CFBE SLED COORDINATE SYSTEM



1. THE MANIKIN FORCES AND TORQUES WERE REFERENCED TO THE MANIKIN COORDINATE SYSTEM.

2. THE NECK AND LUMBAR LOAD CELLS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE FORCE EXERTED BY THE LOAD CELL, ON THE NECK OR LUMBAR, WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

3. THE Mx, My AND Mz TORQUE TRANSDUCERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE TORQUE EXPERIENCED BY THE TRANSDUCER WAS APPLIED IN THE +x, +y OR +z DIRECTION ACCORDING TO THE RIGHT HAND RULE AS SHOWN.

FIGURE A-15: MANIKIN COORDINATE SYSTEM

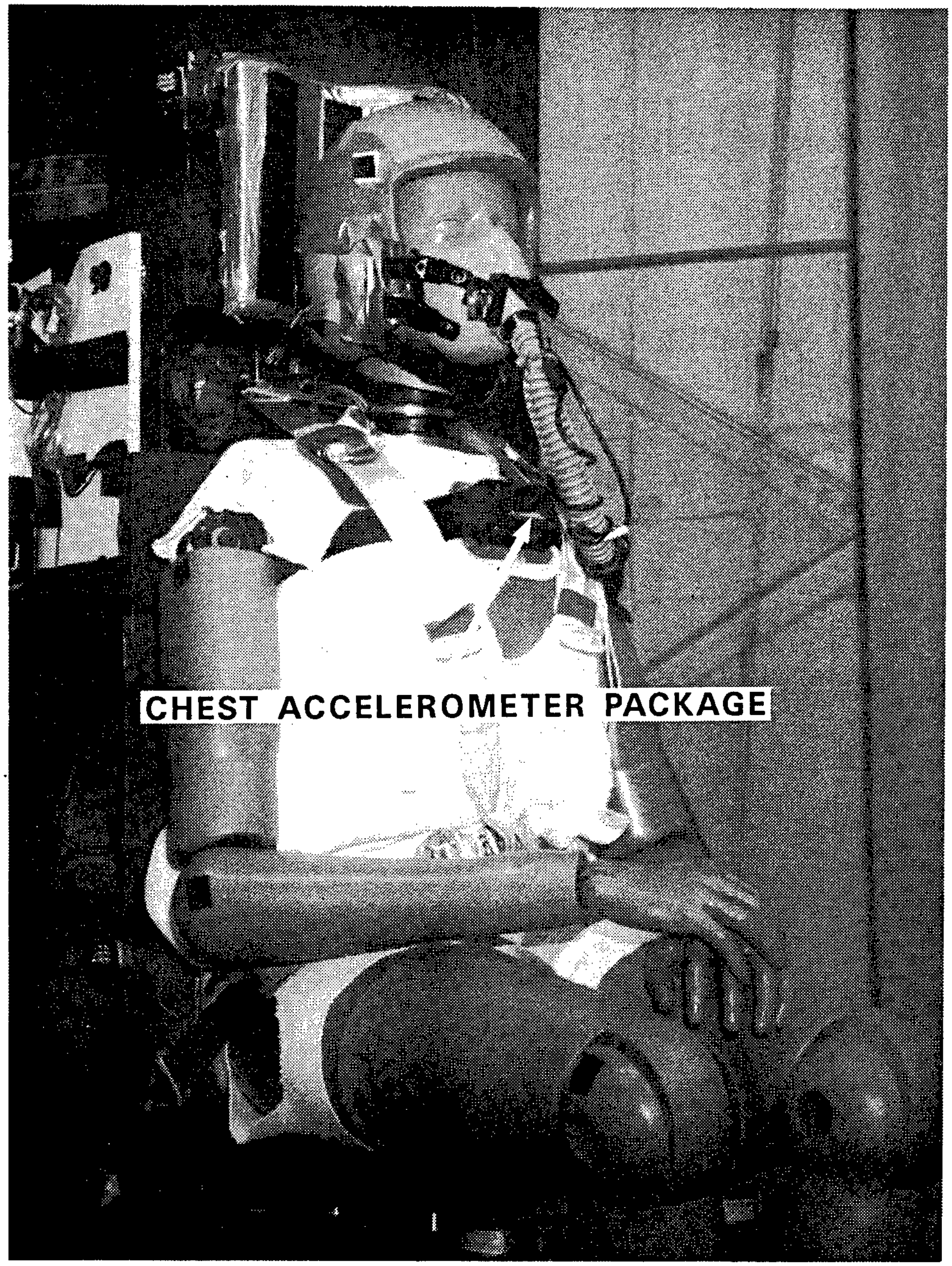
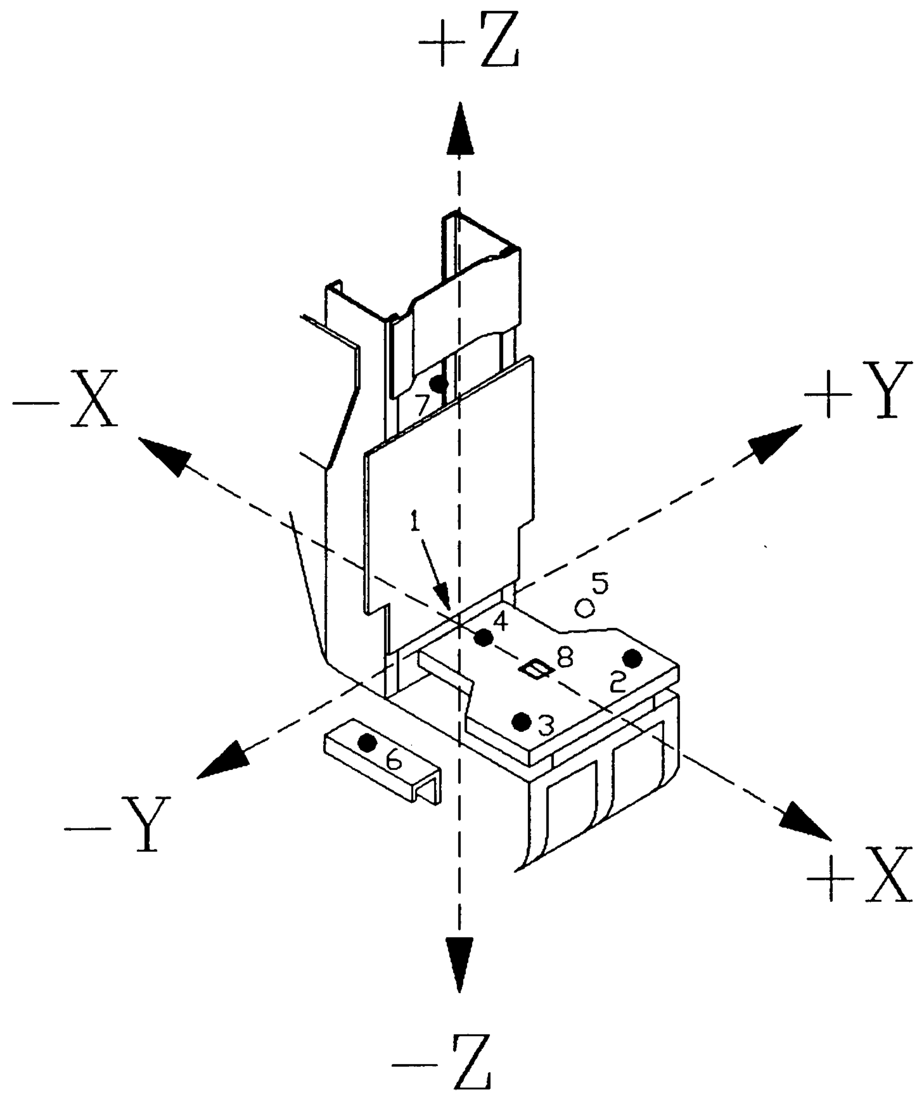


FIGURE A-16: EXTERNAL CHEST ACCELEROMETER PACKAGE



NO.	DESCRIPTION	NO.	DESCRIPTION
1	SEAT REFERENCE POINT	5	LEFT LAP BELT FORCE
2	LEFT SEAT PAN Z FORCE	6	RIGHT LAP BELT FORCE
3	RIGHT SEAT PAN Z FORCE	8	SHOULDER FORCE
4	CENTER SEAT PAN Z FORCE	9	SEAT X, Y & Z ACCELERATION

FIGURE A-17a: +Gz TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS
(PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS). THE SRP WAS NOT REDEFINED TO TAKE INTO ACCOUNT THE BOOSTER SEAT (WHICH IS 2-1/2" THICK) THAT WAS ADDED FOR THE SMALL JPATS MANIKIN TESTS.

CONTACT POINT DIMENSIONS IN INCHES (CM)

NO.	X	Y	Z
1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	17.90 (45.46)	5.00 (12.70)	- 1.38 (- 3.50)
3	17.90 (45.46)	- 5.00 (-12.70)	- 1.38 (- 3.50)
4	6.68 (16.96)	0.00 (0.00)	- 1.38 (- 3.50)
5	0.81 (2.06)	9.00 (22.86)	- 1.77 (- 4.50)
6	0.81 (2.06)	- 9.00 (-22.86)	- 1.77 (- 4.50)
7	- 5.47 (-13.90)	0.00 (0.00)	27.24 (69.18)
8	12.33 (31.31)	0.00 (0.00)	- 1.85 (- 4.70)

(SEE FIGURE A-17a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS)

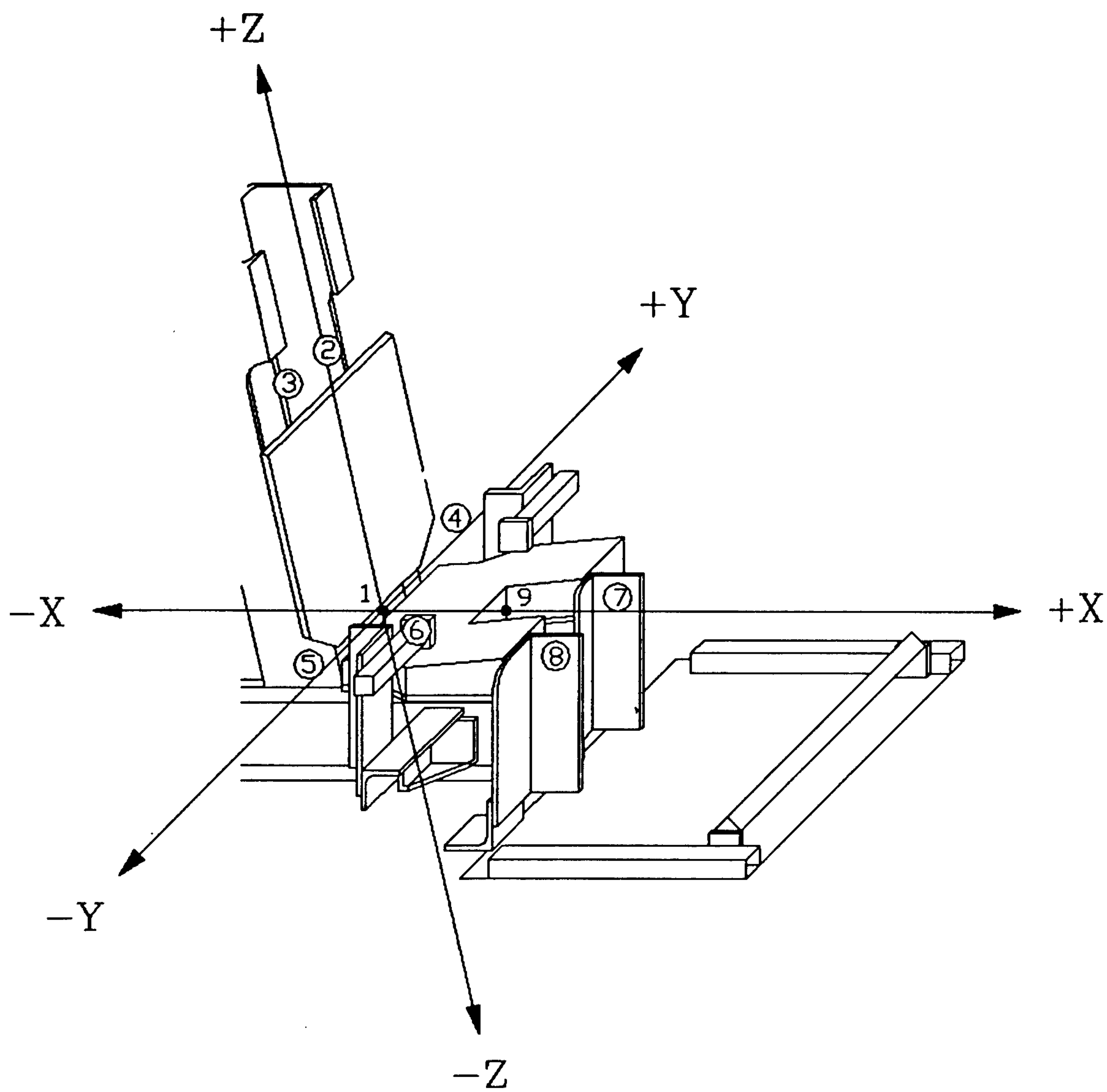
THE SEAT ACCELEROMETER MEASUREMENTS (ITEM 8) ARE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE MEASUREMENTS FOR THE LOAD CELLS WHICH ANCHOR THE HARNESS (ITEMS 5, 6 & 7) ARE TAKEN AT THE POINT WHERE THE HARNESS IS ATTACHED TO THE LOAD CELL.

FIGURE A-17b: +Gz TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS

(PAGE 2 OF 2)



NO.	DESCRIPTION
1	SEAT REFERENCE POINT
2	LEFT SHOULDER BELT FORCE
3	RIGHT SHOULDER BELT FORCE
4	LEFT LAP BELT FORCE
5	RIGHT LAP BELT FORCE
6	RIGHT HIP Y FORCE
7	LEFT KNEE Y FORCE
8	RIGHT KNEE Y FORCE
9	SEAT X, Y & Z ACCELEROMETERS

FIGURE A-18a: +Gy TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS). THE SRP WAS NOT REDEFINED TO TAKE INTO ACCOUNT THE BOOSTER SEAT (WHICH IS 2-1/2" THICK) THAT WAS ADDED FOR THE SMALL JPATS MANIKIN TESTS.

CONTACT POINT DIMENSIONS IN INCHES (CM)

NO.	X	Y	Z
1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	- 2.44 (- 6.20)	5.04 (12.80)	28.03 (71.20)
3	- 2.58 (- 6.55)	- 5.04 (-12.80)	28.07 (71.30)
4	1.29 (3.27)	9.24 (23.47)	- 0.86 (- 2.19)
5	1.40 (3.55)	- 8.77 (-22.27)	- 0.95 (- 2.40)
6	10.26 (26.06)	- 6.90 (-17.53)	3.73 (9.47)
7	23.75 (60.33)	0.41 (1.04)	1.72 (4.37)
8	23.34 (59.29)	-10.58 (-26.87)	1.74 (4.43)
9	10.84 (27.54)	0.00 (0.00)	- 5.54 (-14.08)
***2**	**- 2.14 (- 5.44)**	**2.54 (6.45)**	**28.03 (71.20)**
***3**	**- 2.28 (- 5.79)**	**- 2.54 (- 6.45)**	**28.07 (71.30)**

(SEE FIGURE A-18a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS)

THE SEAT ACCELEROMETER MEASUREMENTS (ITEM 9) WERE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE MEASUREMENTS FOR THE LOAD CELLS WHICH ANCHOR THE HARNESS (ITEMS 2, 3, 4 & 5) WERE TAKEN AT THE POINT WHERE THE HARNESS IS ATTACHED TO THE LOAD CELL.

THE MEASUREMENTS FOR THE HIP LOAD CELL (ITEM 6) WAS TAKEN WITH THE VERTICAL ADJUSTMENT BRACKET (A) LOCATION 2 AND THE HORIZONTAL ADJUSTMENT BRACKET (B) LOCATION 3 (REFERENCE FIGURE A-19).

THE MEASUREMENTS FOR THE LEFT KNEE LOAD CELL (ITEM 7) WERE TAKEN WITH THE VERTICAL ADJUSTMENT BRACKET POSITION 2.

THE MEASUREMENTS FOR THE RIGHT KNEE LOAD CELL (ITEM 8) WERE TAKEN WITH THE VERTICAL ADJUSTMENT BRACKET (C) POSITION 2 AND THE HORIZONTAL ADJUSTMENT BRACKET (D) POSITION 1 (REFERENCE FIGURE A-20).

*** LEFT SHOULDER AND RIGHT SHOULDER (ITEMS 2 & 3) MEASUREMENTS FOR SMALL JPATS MANIKIN TESTS ONLY.**

FIGURE A-18b: +Gy TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 2 OF 2)

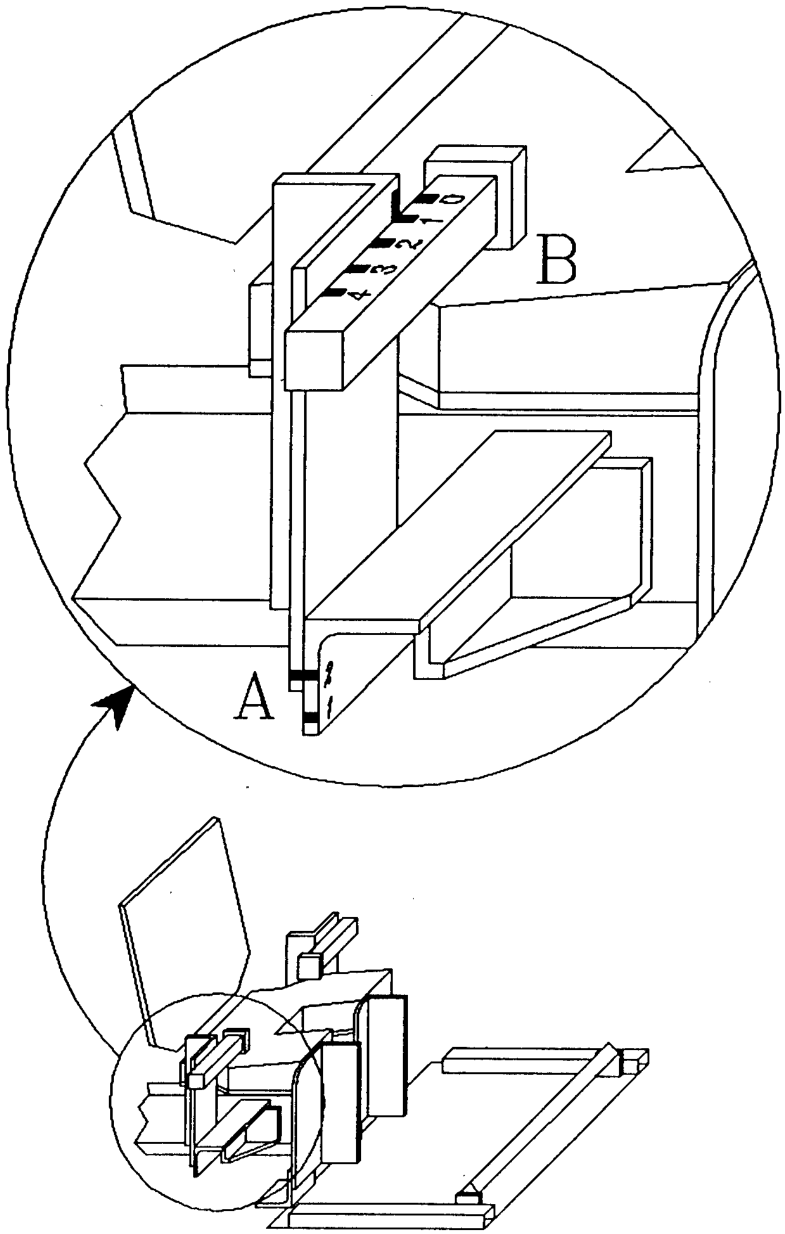


FIGURE A-19: HIP LOAD CELL ADJUSTMENT BRACKETS

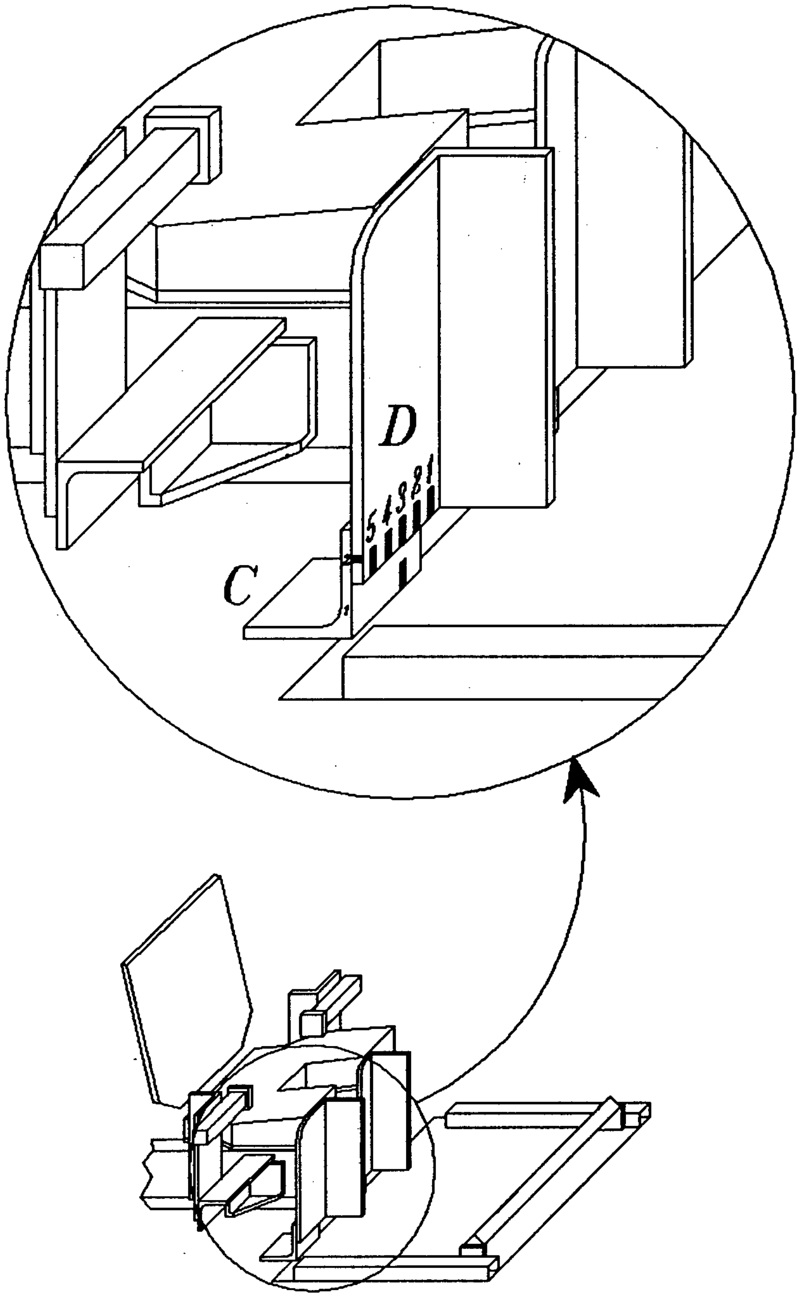
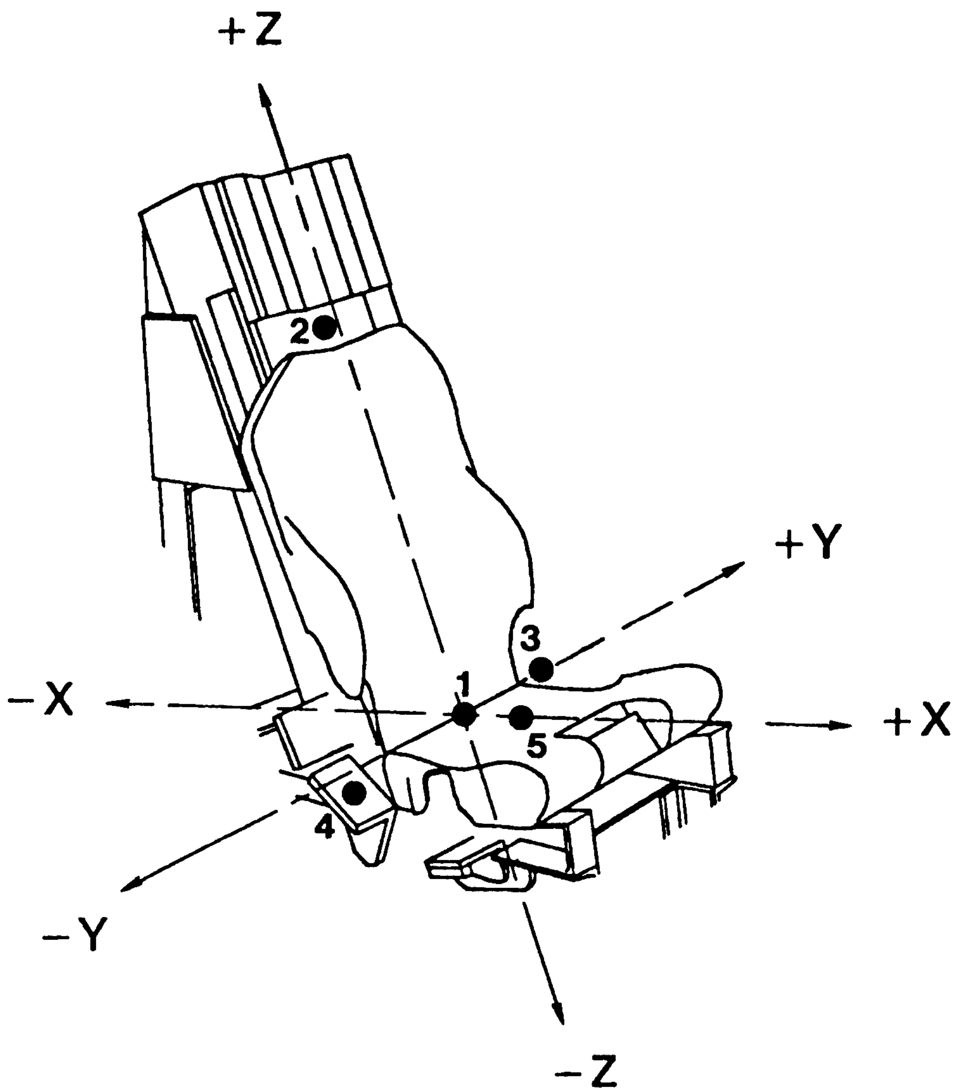


FIGURE A-20: RIGHT KNEE LOAD CELL ADJUSTMENT BRACKETS



NO.	DESCRIPTION
1	SEAT REFERENCE POINT
2	SHOULDER FORCE
3	LEFT LAP BELT FORCE
4	RIGHT LAP BELT FORCE
5	SEAT X, Y & Z ACCELEROMETERS

FIGURE A-21a: +Gy AND -Gx TEST CONFIGURATION (CONTOURED SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

CONTACT POINT DIMENSIONS IN INCHES (CM)

NO.	X	Y	Z
1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	- 9.40 (-23.89)	0.00 (0.00)	28.66 (72.79)
3	- 0.96 (- 2.44)	8.22 (20.89)	0.47 (1.20)
4	- 0.99 (- 2.51)	- 8.21 (-20.85)	0.65 (1.65)
5	5.91 (15.01)	0.00 (0.00)	- 3.40 (- 8.65)

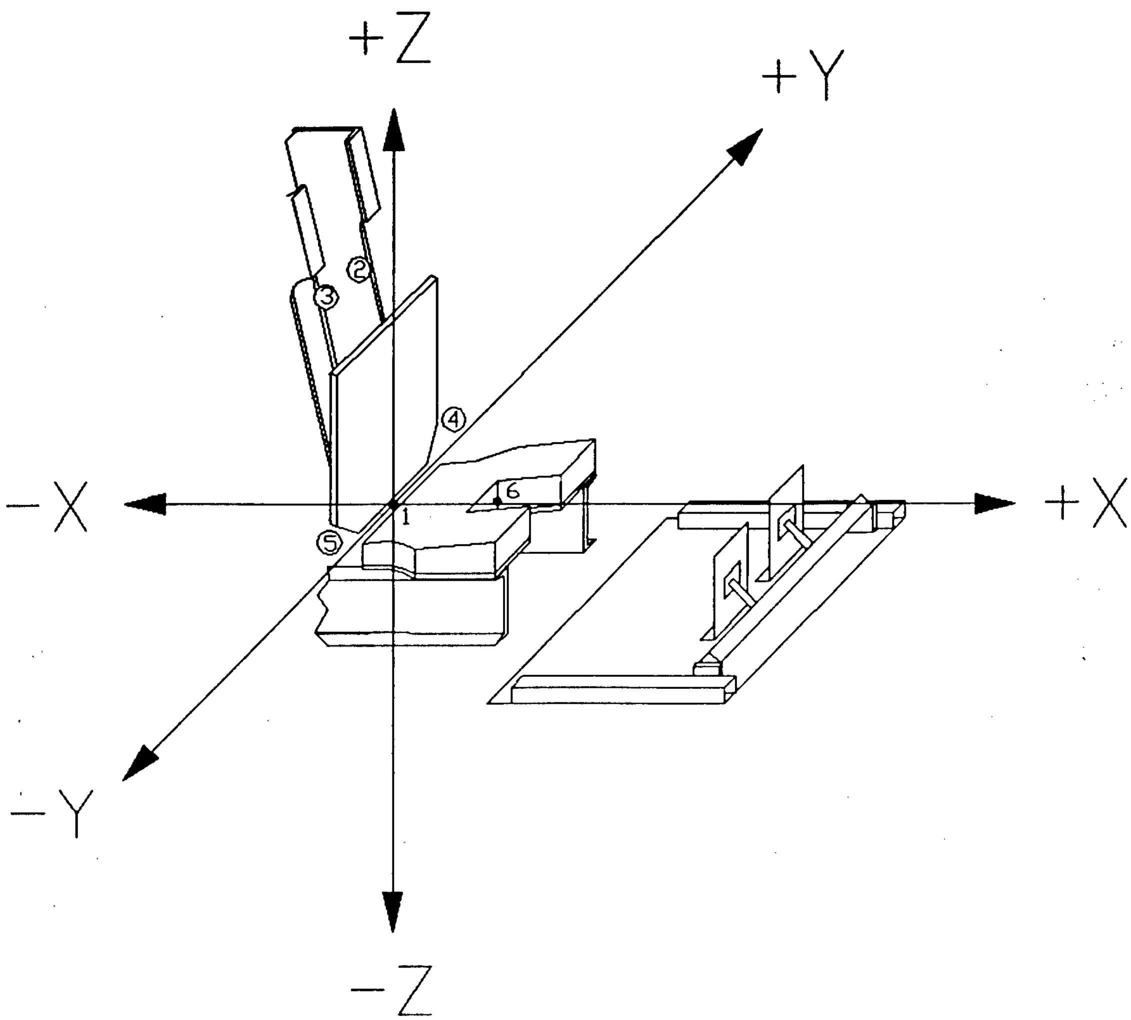
(SEE FIGURE A-21a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS)

THE SEAT ACCELEROMETER MEASUREMENTS (ITEM 5) ARE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE MEASUREMENTS FOR THE LOAD CELLS WHICH ANCHOR THE HARNESS (ITEMS 2, 3 & 4) ARE TAKEN AT THE POINT WHERE THE HARNESS IS ATTACHED TO THE LOAD CELL.

FIGURE A-21b: +Gy AND -Gx TEST CONFIGURATION (CONTOURED SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 2 OF 2)



NO.	DESCRIPTION
1	SEAT REFERENCE POINT
2	LEFT SHOULDER BELT FORCE
3	RIGHT SHOULDER BELT FORCE
4	LEFT LAP BELT FORCE
5	RIGHT LAP BELT FORCE
6	SEAT X ACCELEROMETER

FIGURE A-22a: -Gx TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

CONTACT POINT DIMENSIONS IN INCHES (CM)

NO.	X	Y	Z
1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	- 3.18 (- 8.07)	2.44 (6.21)	26.02 (66.10)
3	- 3.18 (- 8.07)	- 2.44 (- 6.21)	26.07 (66.21)
4	2.21 (5.61)	9.01 (22.89)	- 2.00 (- 5.08)
5	2.01 (5.11)	- 9.01 (-22.89)	- 2.11 (- 5.37)
6	13.64 (34.65)	0.00 (0.00)	- 4.70 (-11.95)

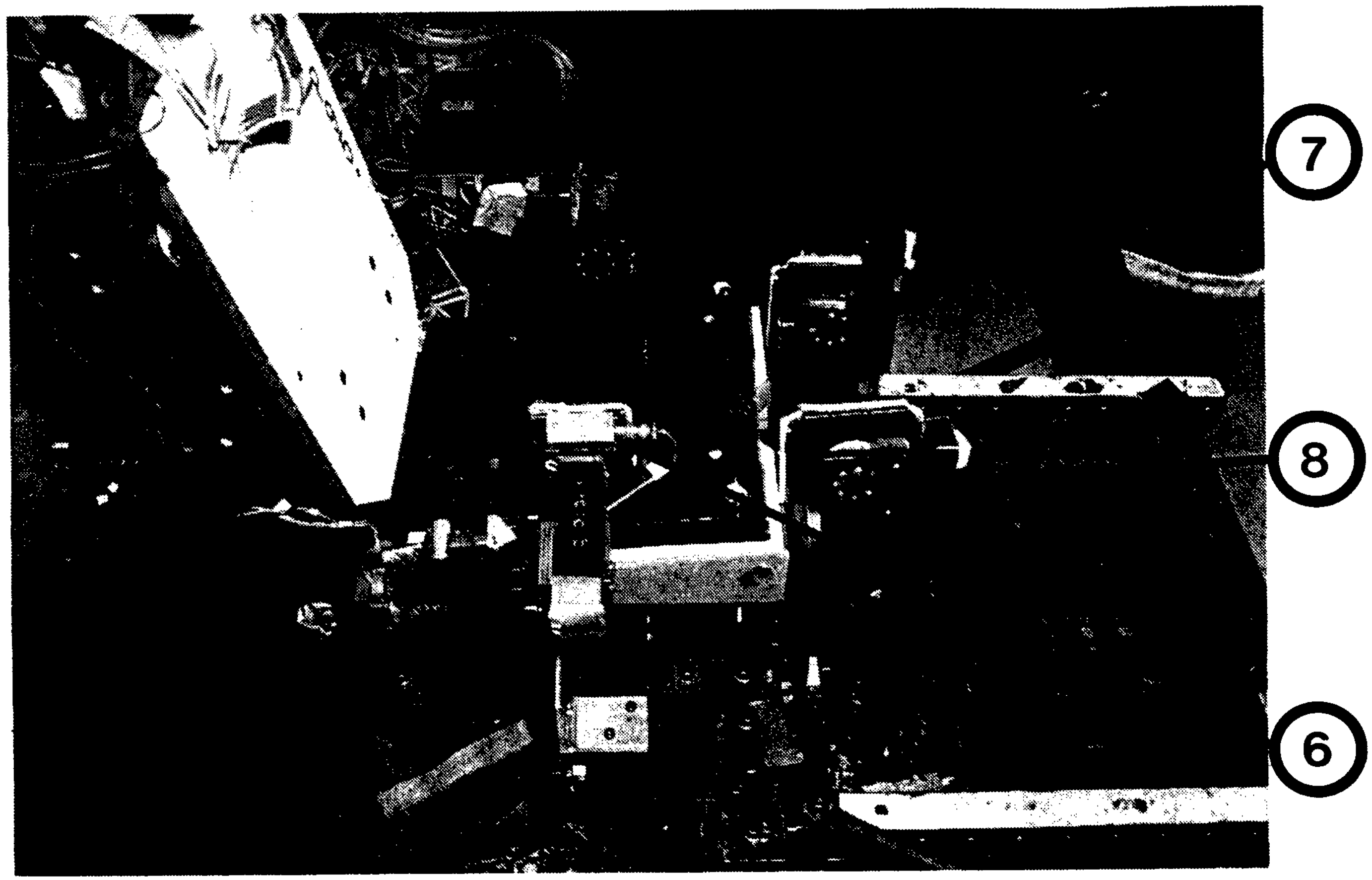
(SEE FIGURE A-22a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS)

THE SEAT ACCELEROMETER MEASUREMENTS (ITEM 6) WERE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE MEASUREMENTS FOR THE LOAD CELLS WHICH ANCHOR THE HARNESS (ITEMS 2, 3, 4 & 5) WERE TAKEN AT THE POINT WHERE THE HARNESS IS ATTACHED TO THE LOAD CELL.

FIGURE A-22b: -Gx TEST CONFIGURATION (FLAT SEAT) TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 2 OF 2)



SEE FIGURE A-18a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS

FIGURE A-23: HIP AND KNEE LOAD CELL INSTRUMENTATION

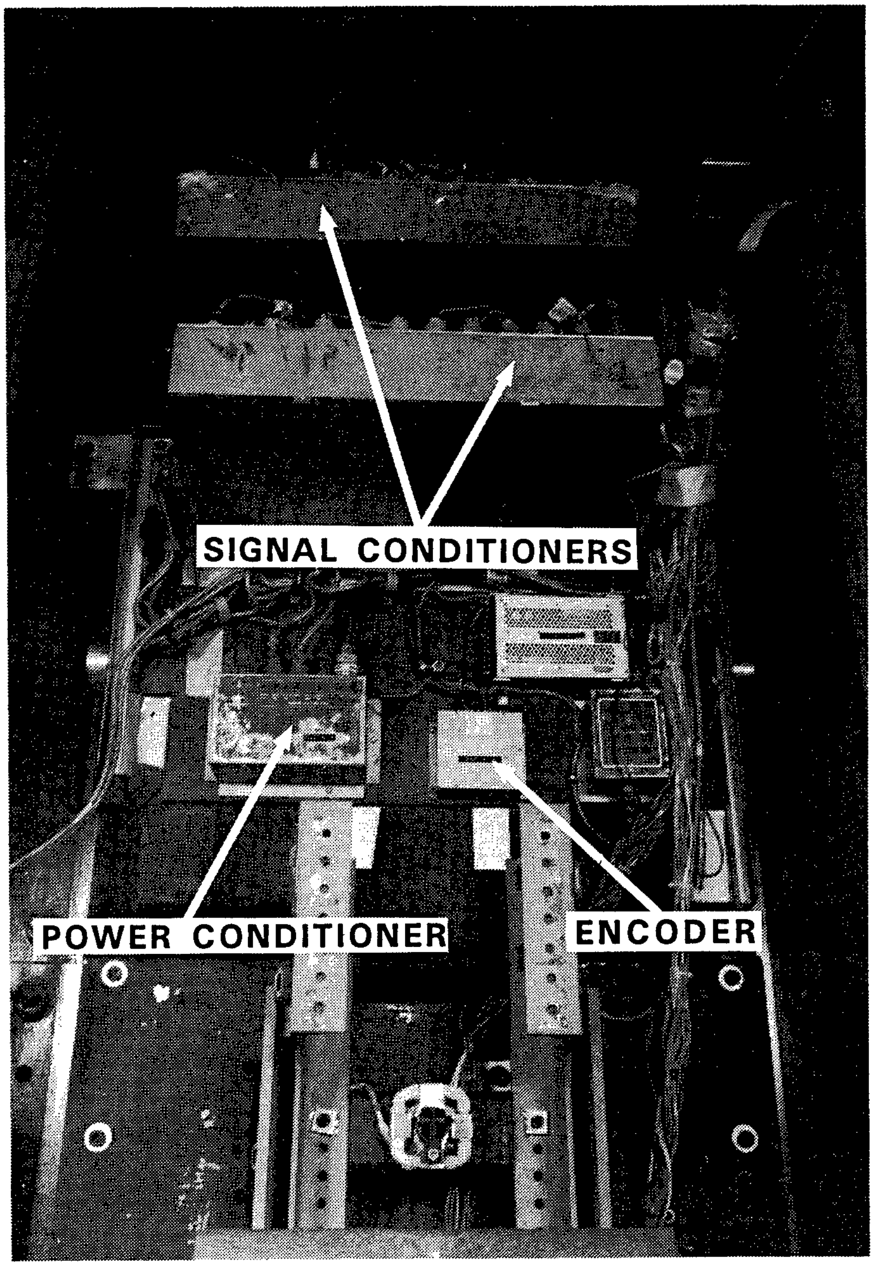
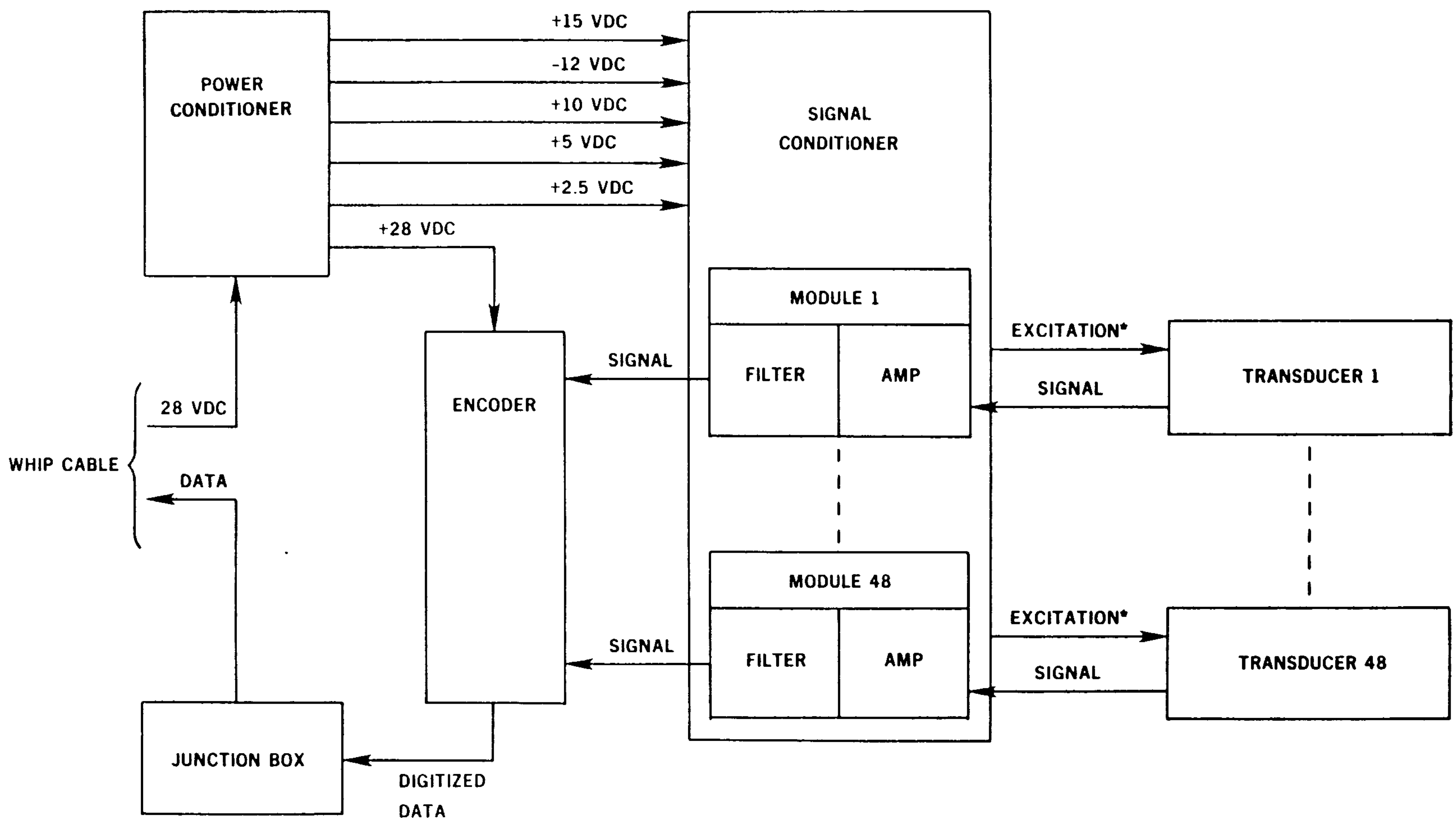


FIGURE A-24: ADACS INSTALLATION (+Gz TEST CONFIGURATION)



* +10 OR +5 VDC, FOR BRIDGE-TYPE TRANSDUCERS ONLY.

FIGURE A-25: AUTOMATIC DATA ACQUISITION AND CONTROL SYSTEM

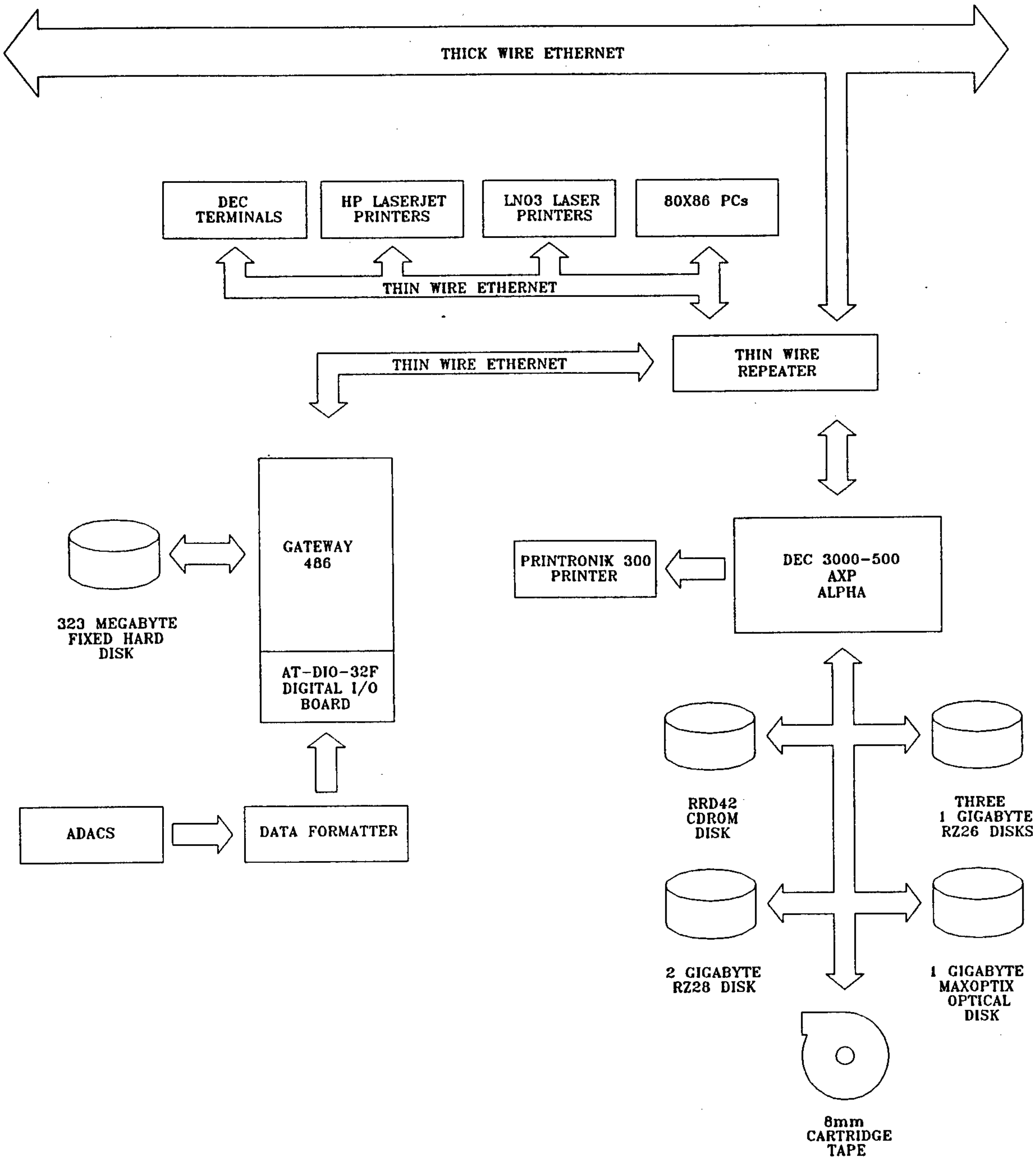


FIGURE A-26: DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM

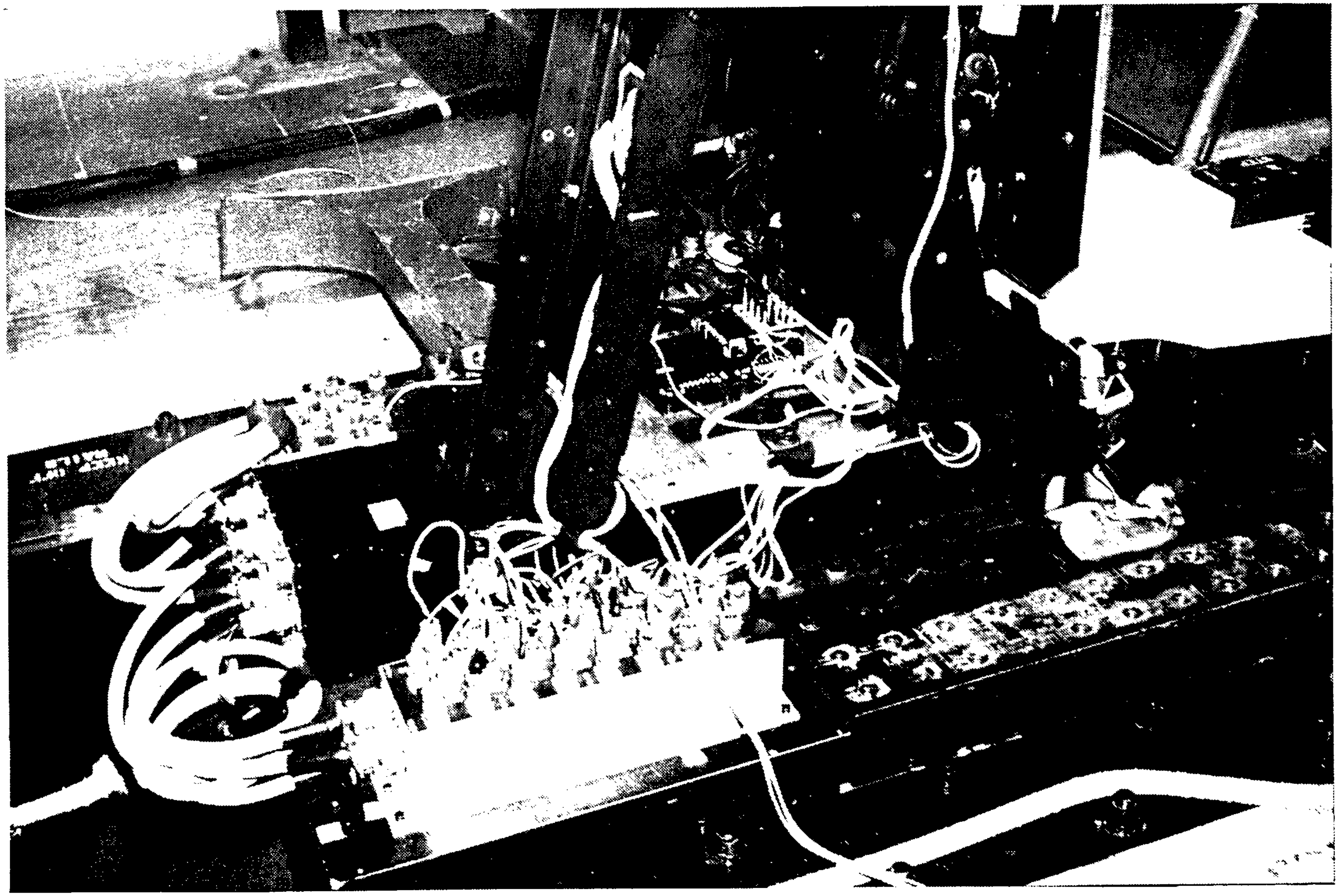


FIGURE A-27: EME DAS-64 INSTALLATION (+Gy AND -Gx TEST CONFIGURATION)

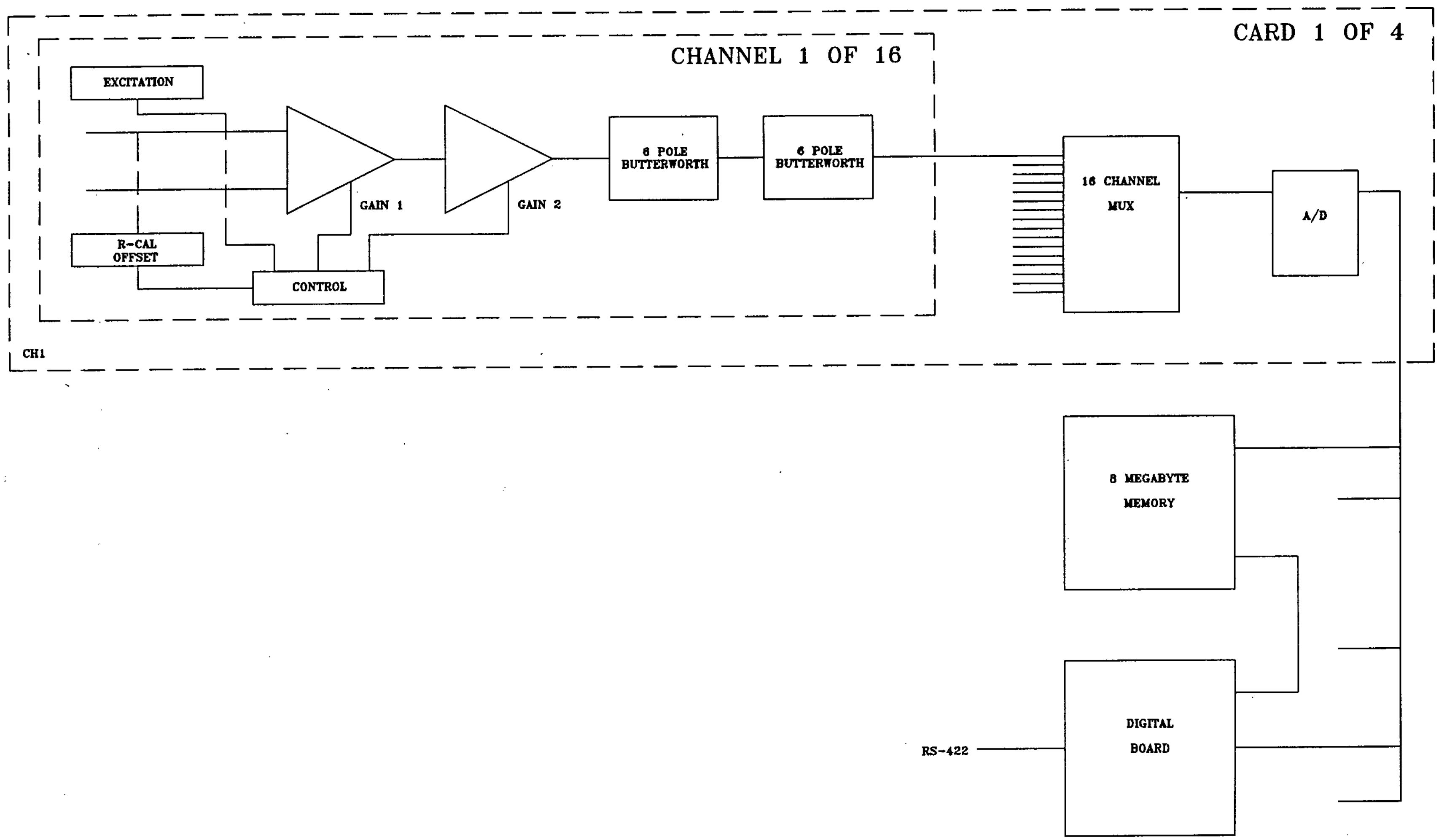


FIGURE A-28: EME DAS-64 DATA ACQUISITION SYSTEM

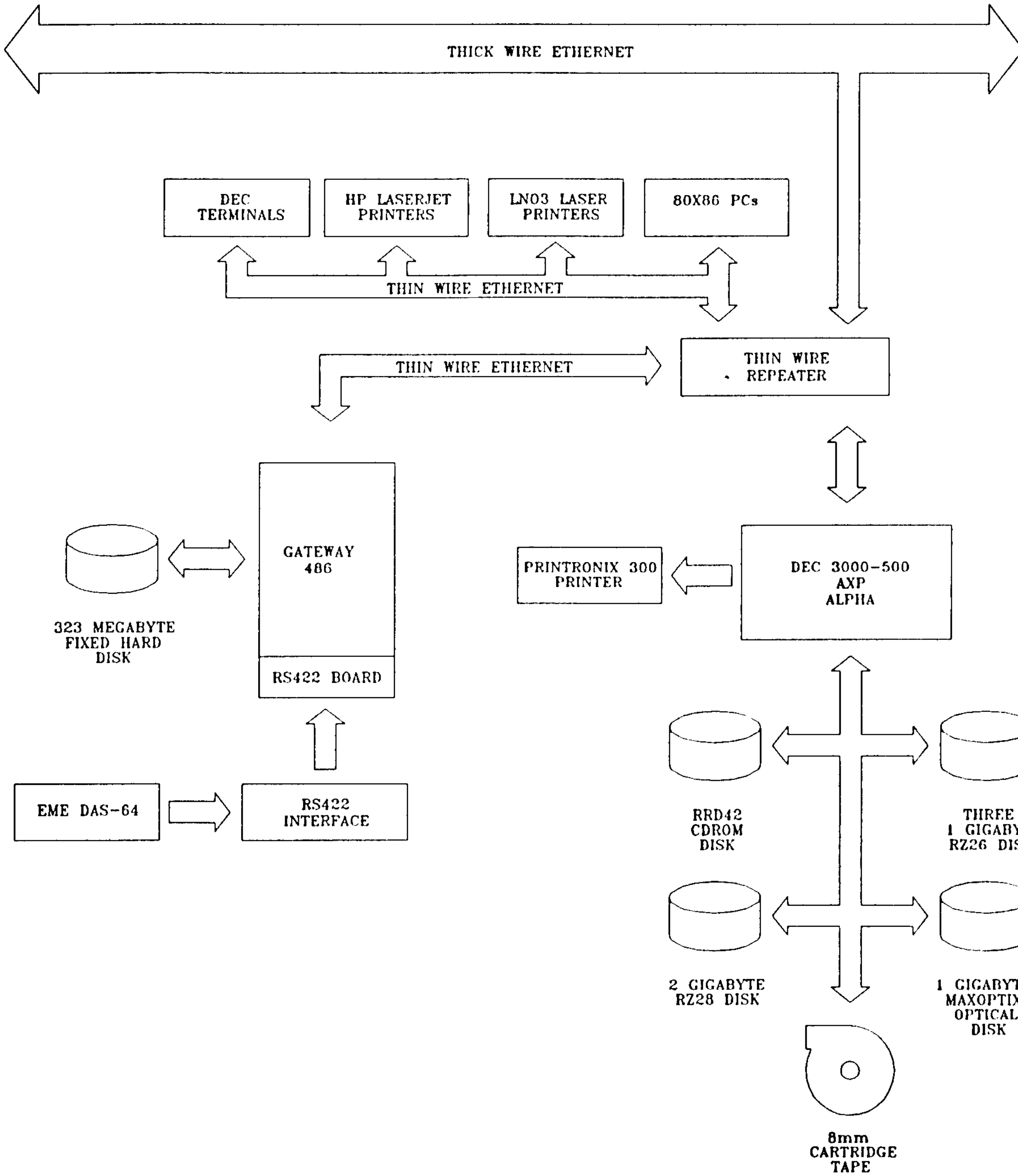


FIGURE A-29: EME DAS-64 DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM

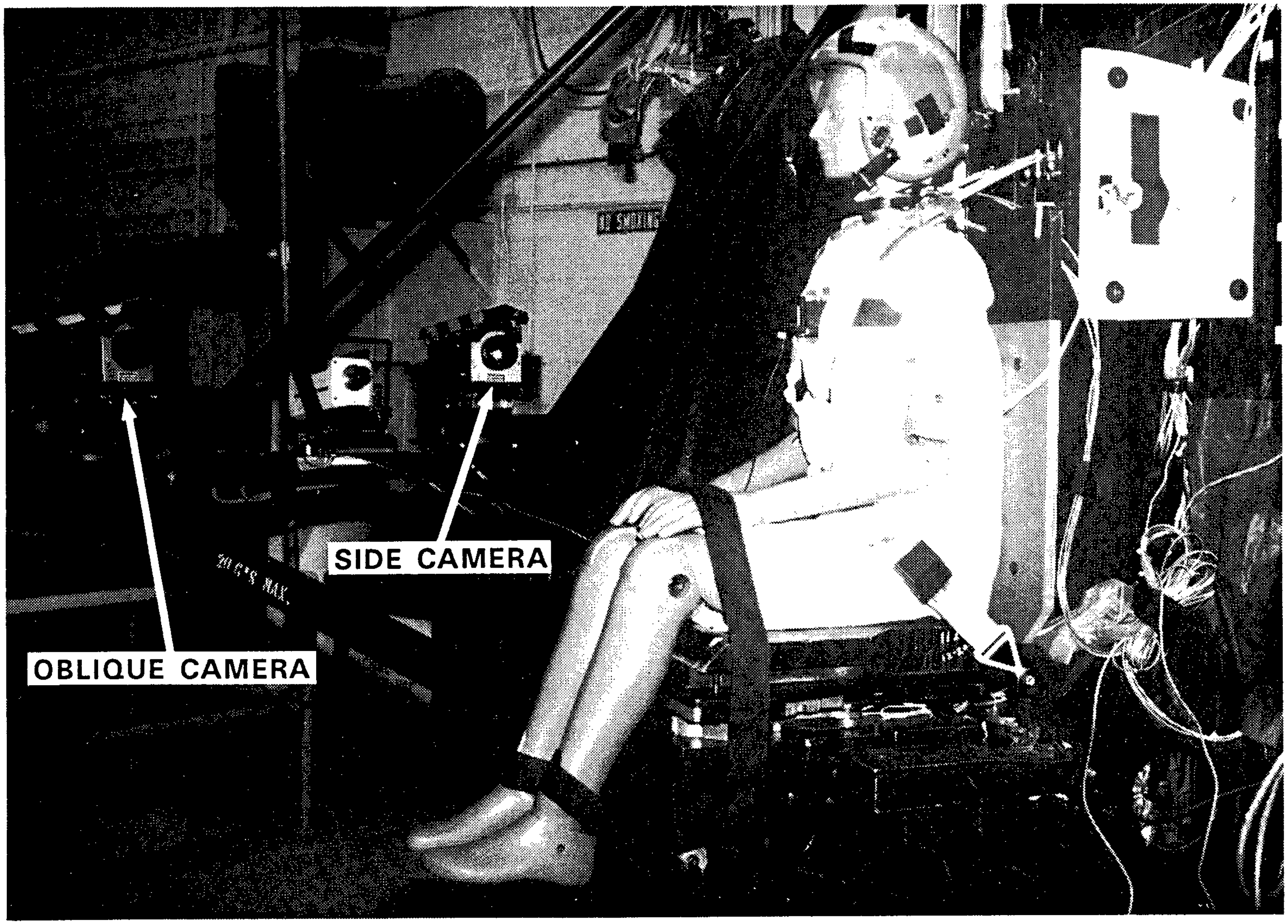


FIGURE A-30: ONBOARD SELSPOT CAMERA LOCATIONS (+Gz TEST CONFIGURATION)

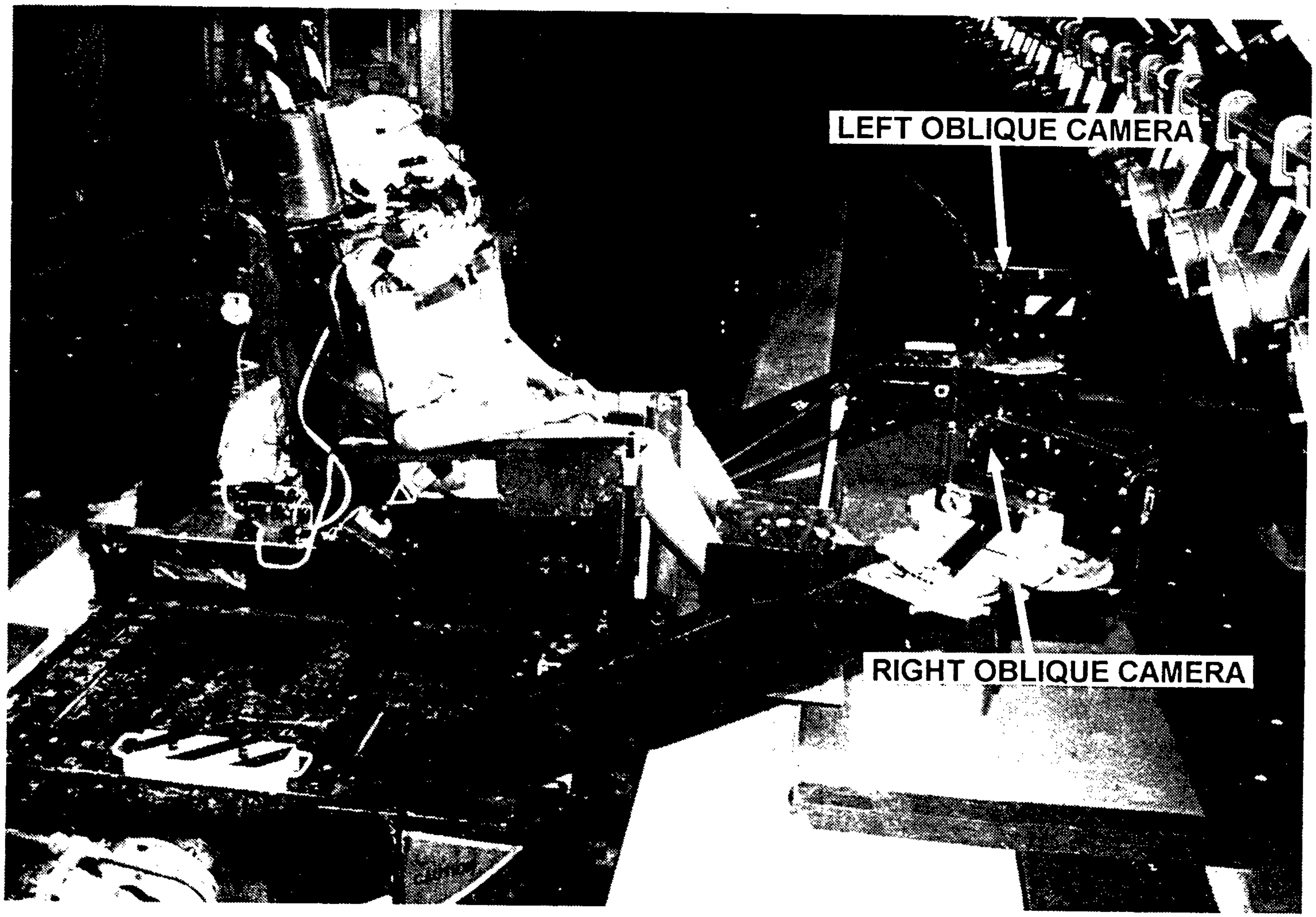


FIGURE A-31: ONBOARD SELSPOT CAMERA LOCATIONS (+Gy TEST CONFIGURATION)

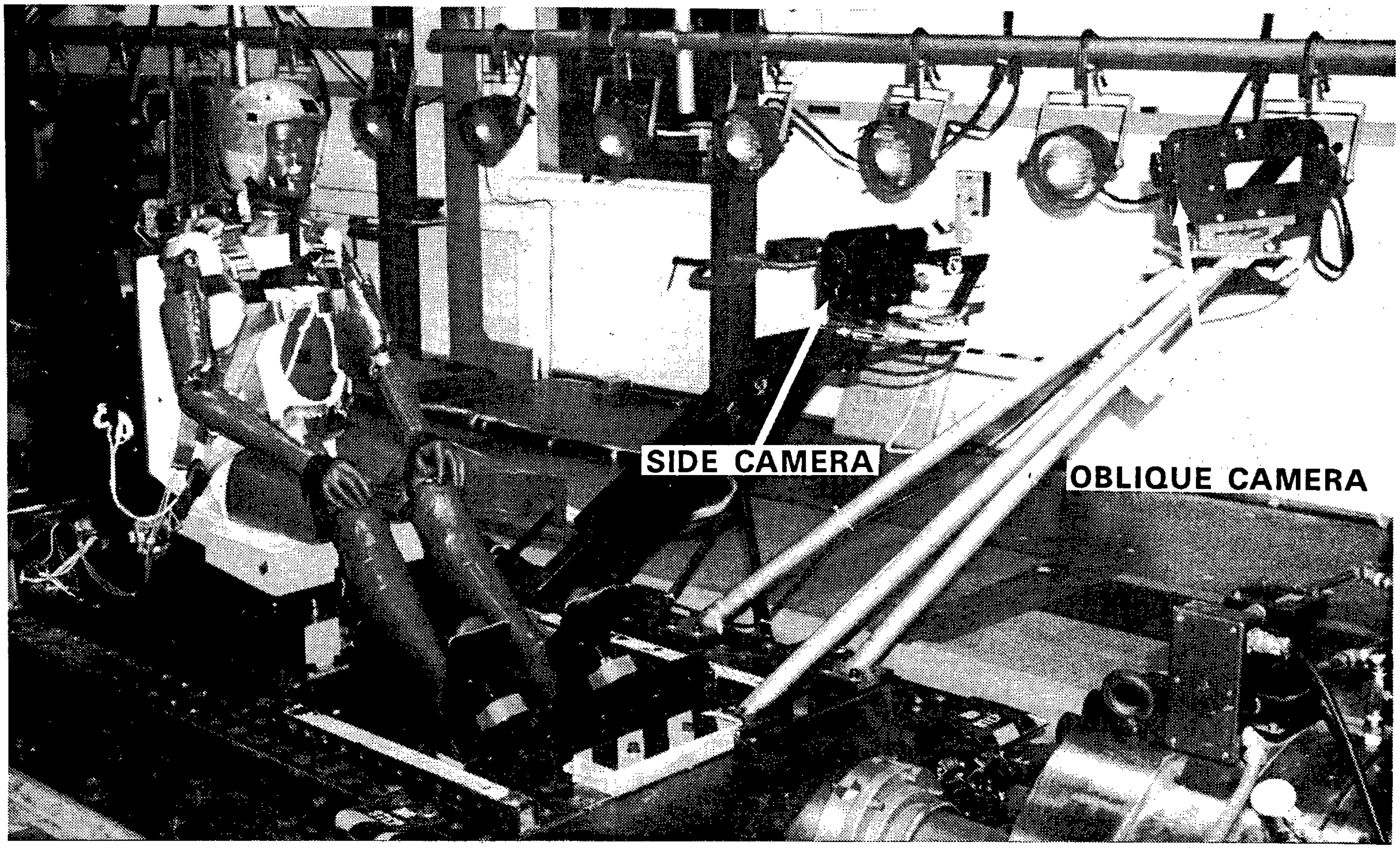


FIGURE A-32: ONBOARD SELSPOT CAMERA LOCATIONS (-Gx TEST CONFIGURATION FOR CELLS J AND J1)

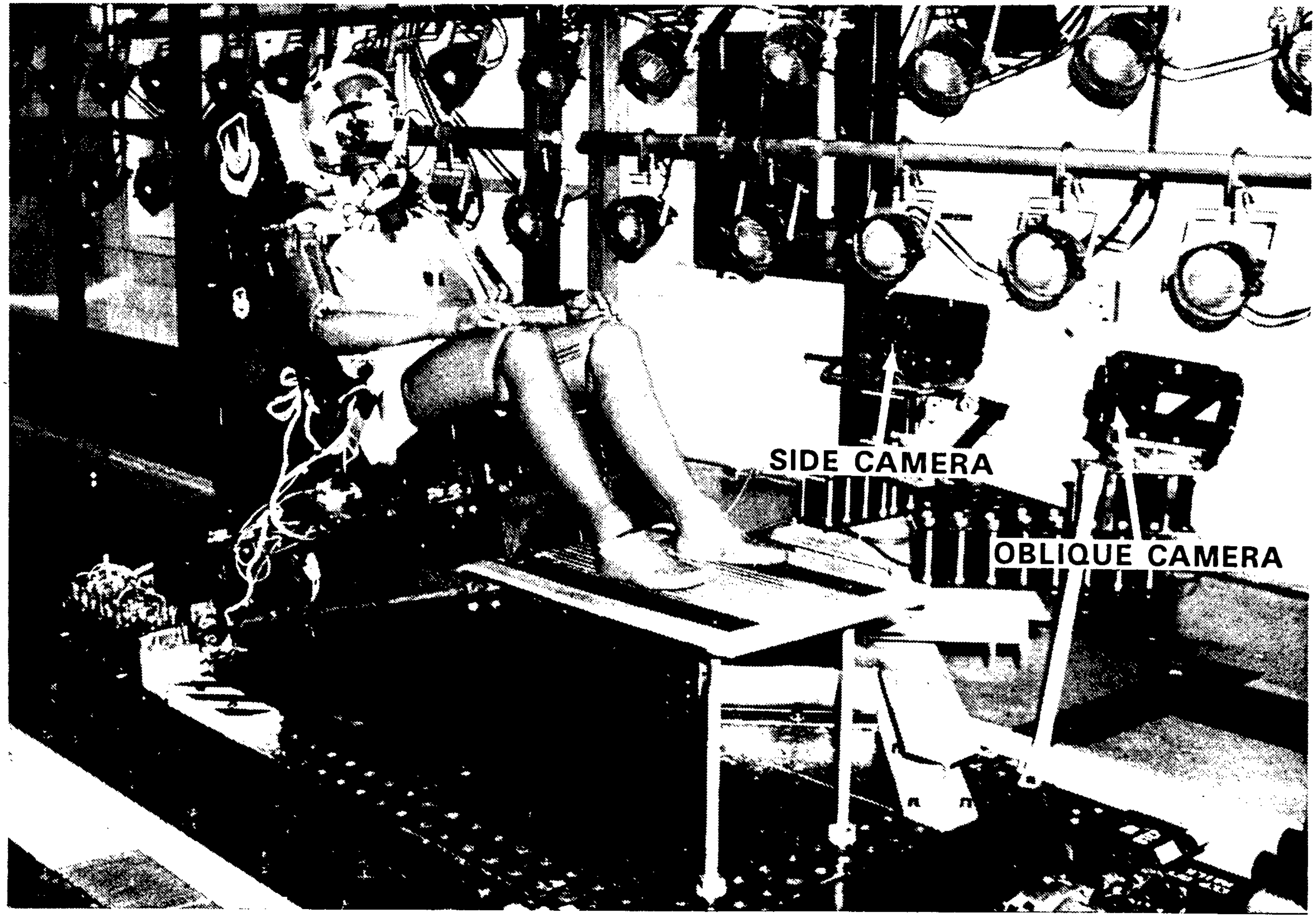


FIGURE A-33: ONBOARD SELSPOT CAMERA LOCATIONS (-Gx TEST CONFIGURATION FOR CELLS K AND L)

FIGURE A-34: SELSPOT COMPUTER SYSTEM

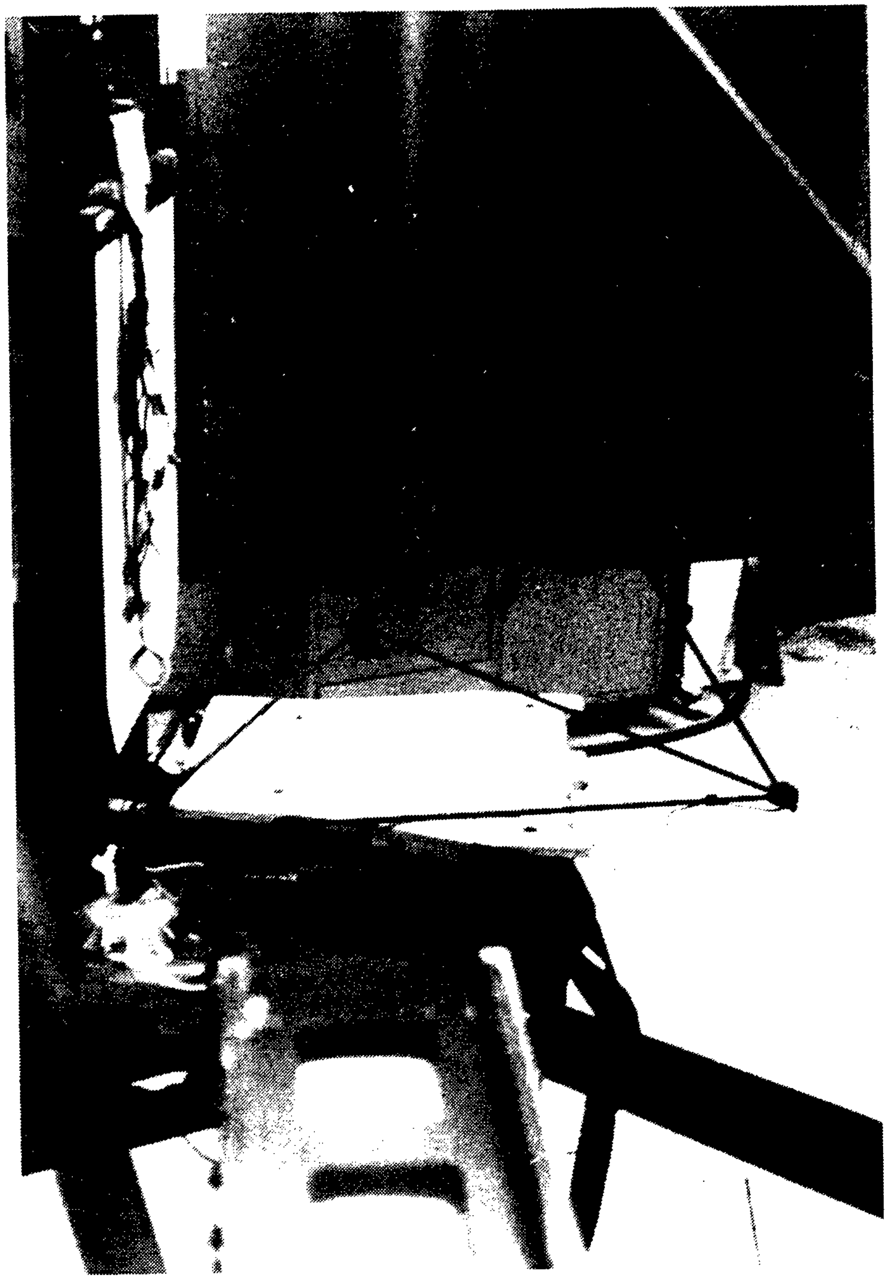
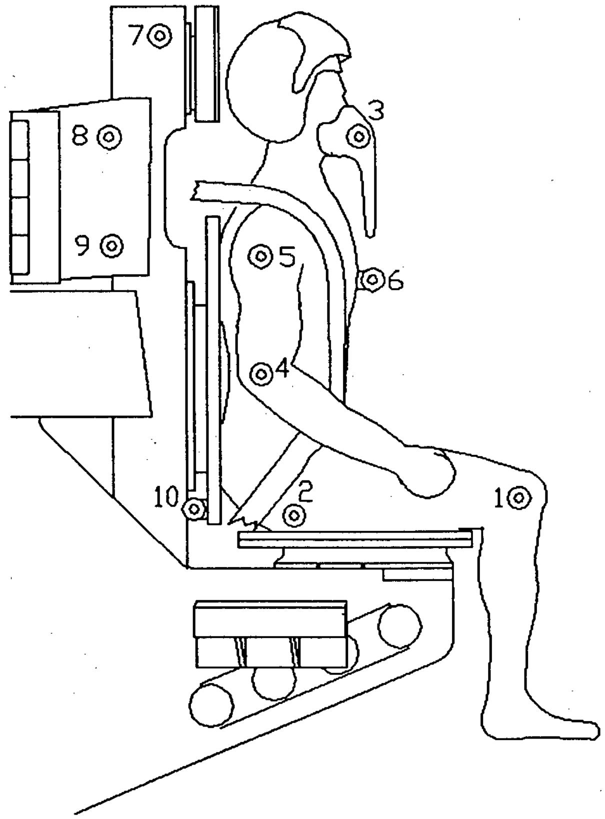


FIGURE A-35: POSITION REFERENCE STRUCTURE (PRS)



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

	DESCRIPTION	DIMENSIONS IN MILLIMETERS x	y	z
1.	KNEE	-	-	-
2.	HIP	-	-	-
3.	CHEEK	-	-	-
4.	ELBOW	-	-	-
5.	SHOULDER	-	-	-
6.	CHEST	-	-	-
7.	UPPER FRAME	- 46.80	-161.30	+1017.60
8.	UPPER NUMBER PLATE	-242.80	-251.10	+ 823.40
9.	LOWER NUMBER PLATE	-243.60	-256.50	+ 547.10
10.	LOWER FRAME	- 42.40	-234.10	+ 121.30

FIGURE A-36: +Gz TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS

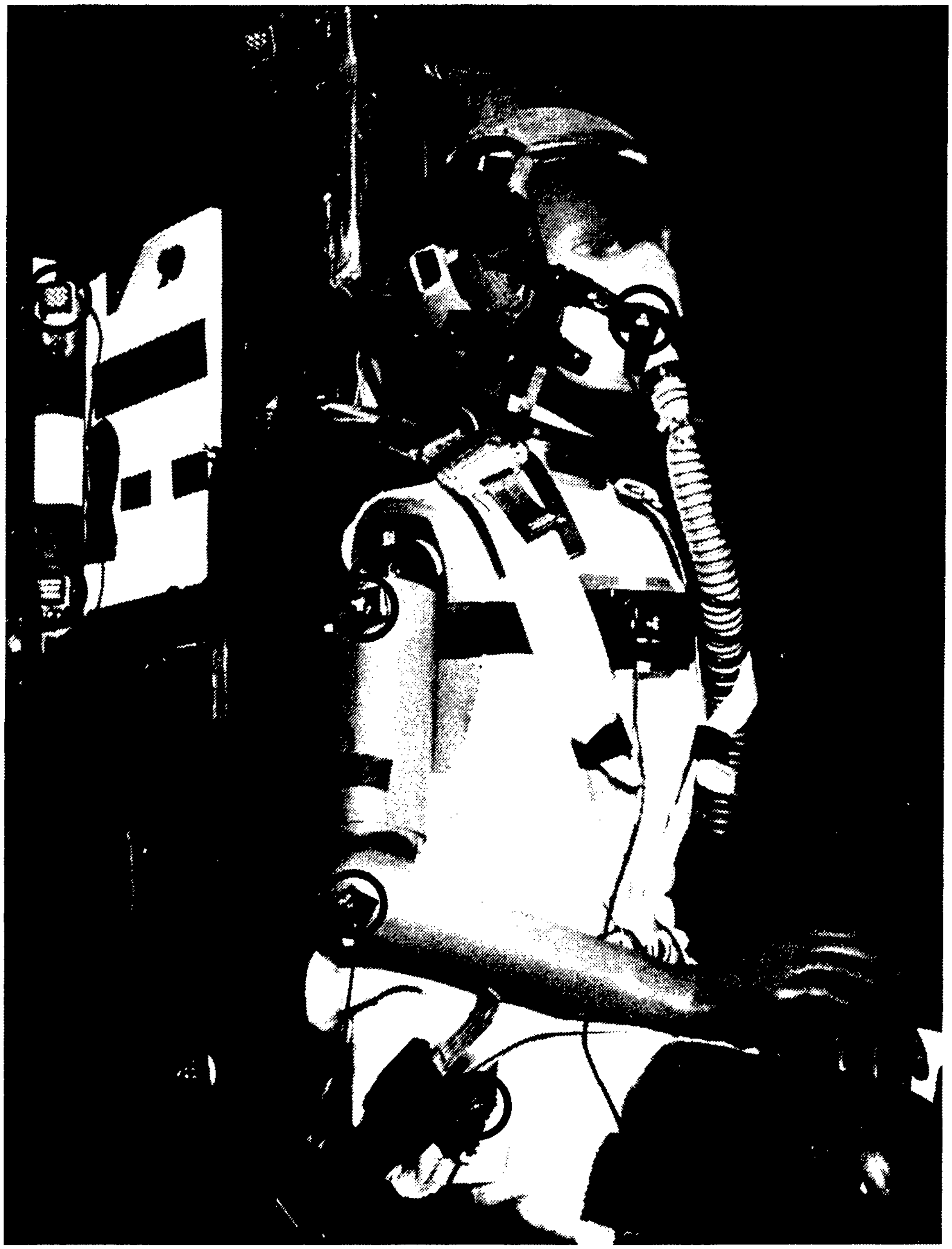


FIGURE A-37: +Gz TEST CONFIGURATION INFRARED TARGETS

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

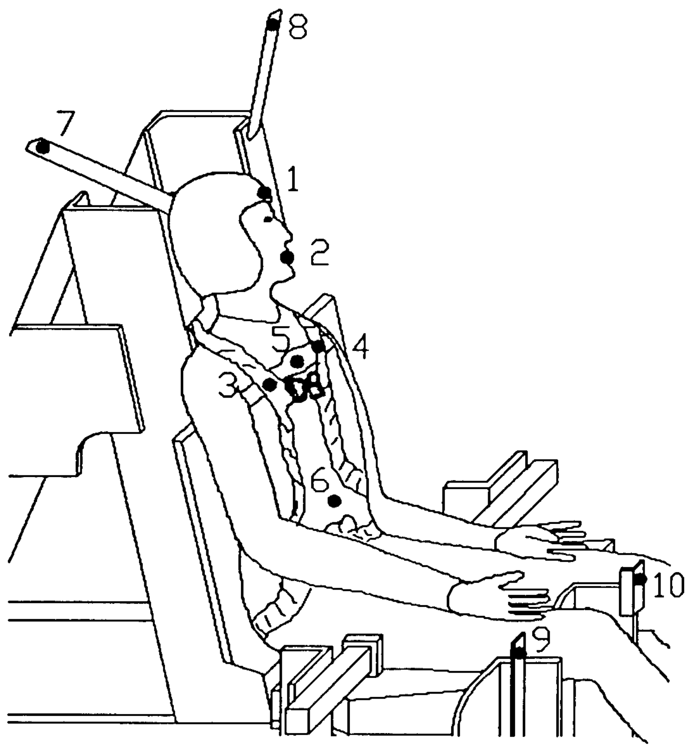
DESCRIPTION	DIMENSIONS IN MILLIMETERS		
	x	y	z
1. FOREHEAD	-	-	-
2. MOUTH	-	-	-
3. LEFT SHOULDER	-	-	-
4. RIGHT SHOULDER	-	-	-
5. CHEST	-	-	-
6. WAIST	-	-	-

CELL F TESTS FIXED TARGET LOCATIONS:			
7. RIGHT HEADREST	- 6.10	-200.70	+1219.73
8. LEFT HEADREST	- 4.00	+204.00	+1227.87
9. RIGHT KNEE SUPPORT	+639.83	-394.20	+ 157.51
SMALL JPATS MANIKIN:			
10. LEFT KNEE SUPPORT	+683.40	- 40.70	+ 142.62
LARGE JPATS AND LARGE ADAM MANIKIN:			
10. LEFT KNEE SUPPORT	+720.52	- 40.70	+ 134.05

CELL H AND I TESTS FIXED TARGET LOCATIONS:			
7. RIGHT HEADREST	- 12.96	-157.00	+1179.24
8. LEFT HEADREST	- 28.83	+178.90	+1179.41
9. RIGHT KNEE SUPPORT	+675.77	-319.20	+ 106.93
10. LEFT KNEE SUPPORT	+716.57	+ 60.60	+ 96.48

CELL G AND G1 TESTS FIXED TARGET LOCATIONS:			
7. RIGHT HEADREST	- 12.96	-157.00	+1179.24
8. LEFT HEADREST	- 28.83	+178.90	+1179.41
9. UPPER ROD	+573.62	+278.00	+ 476.17
10. LOWER ROD	+496.69	+282.70	+ 163.87

FIGURE A-38a: +Gy TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS
(PAGE 1 OF 2)



SEE FIGURE A-38a FOR DESCRIPTIONS OF INFRARED TARGET (LED) ITEM NUMBERS

NOTE: LED ITEMS 9 & 10 (UPPER & LOWER ROD) NOT SHOWN FOR CELL G AND G1 TESTS

FIGURE A-38b: +Gy TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS
(PAGE 2 OF 2)

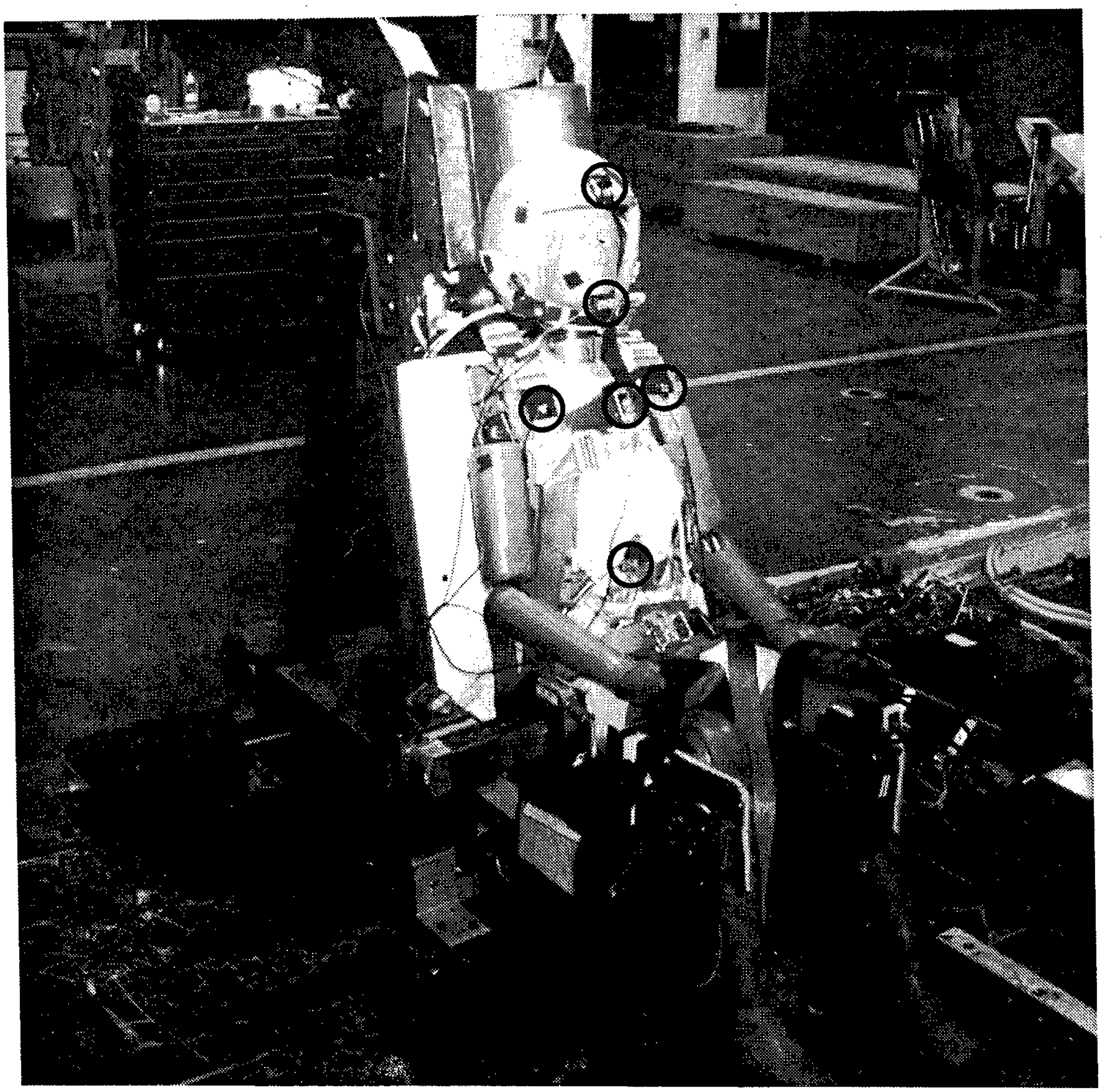


FIGURE A-39: +Gy TEST CONFIGURATION INFRARED TARGETS
(FOR CELL F TESTS)

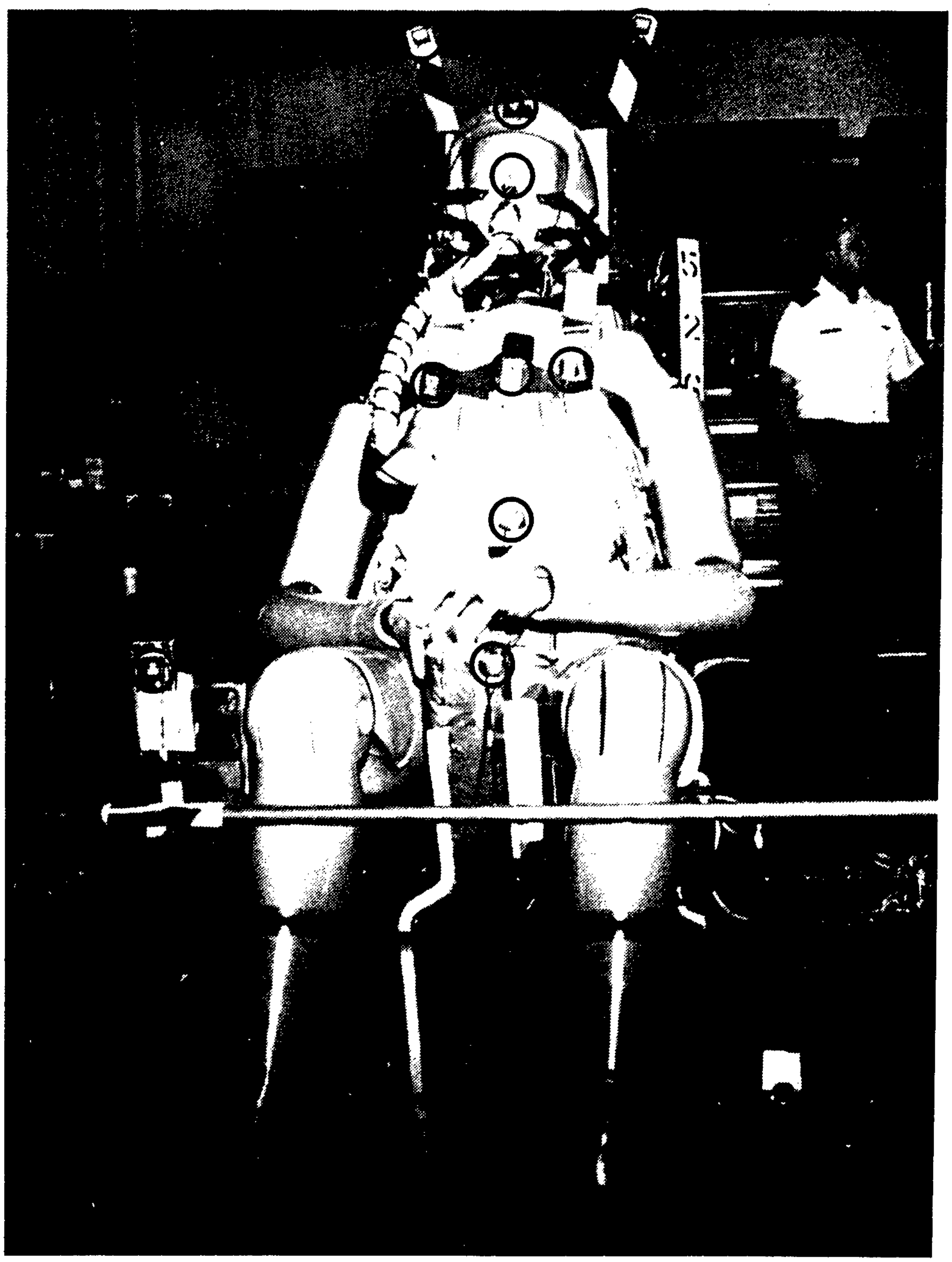


FIGURE A-40: +Gy TEST CONFIGURATION INFRARED TARGETS
(FOR CELL H AND I TESTS)

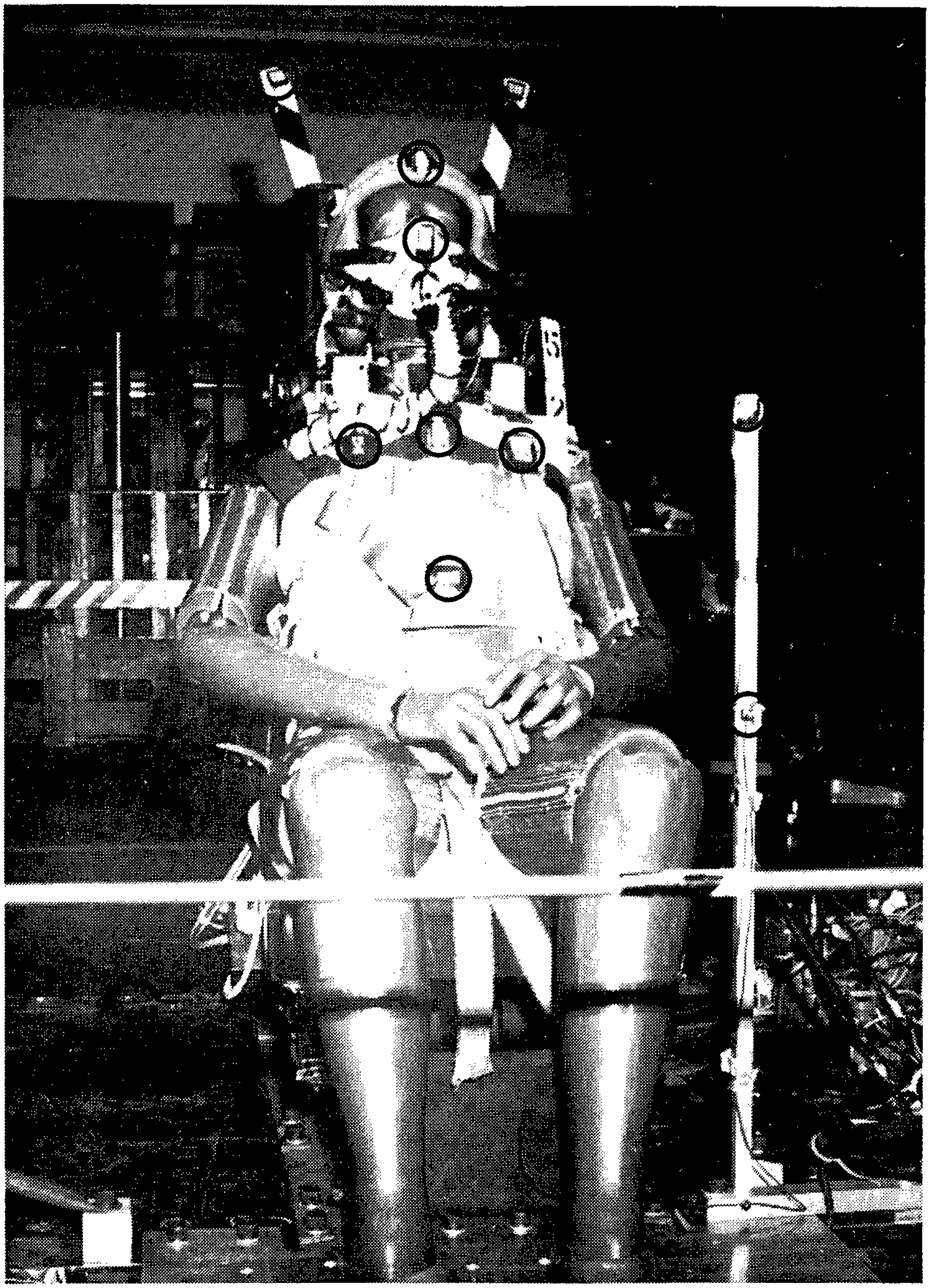
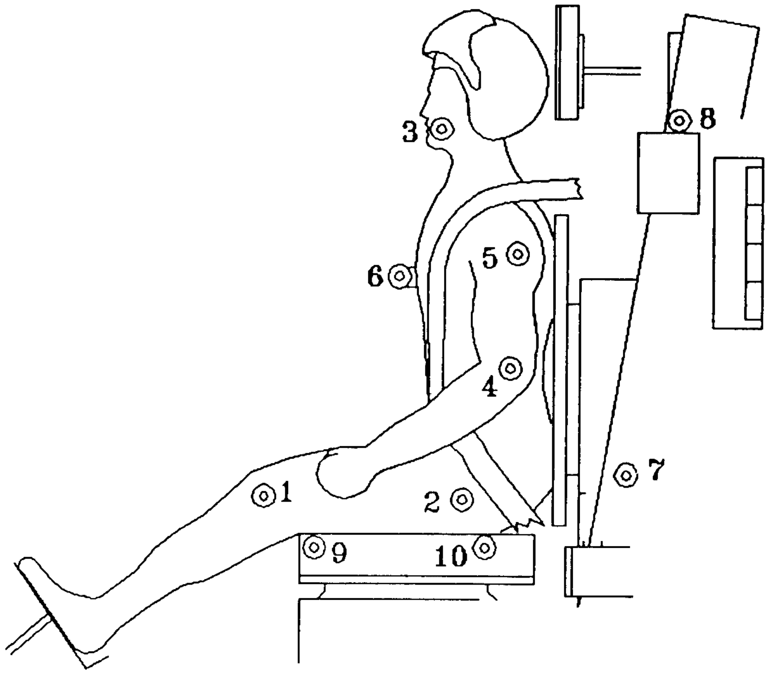


FIGURE A-41: +Gy TEST CONFIGURATION INFRARED TARGETS (FOR CELL G AND G1 TESTS)



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

	DESCRIPTION	DIMENSIONS IN MILLIMETERS		
		x	y	z
1.	KNEE	-	-	-
2.	HIP	-	-	-
3.	CHIN	-	-	-
4.	ELBOW	-	-	-
5.	SHOULDER	-	-	-
6.	CHEST	-	-	-
7.	LOWER FRAME	-212.50	-164.00	+ 118.50
8.	UPPER FRAME	-251.00	+215.00	+ 564.90
9.	FORE SEAT PAN	+435.20	+250.00	- 42.40
10.	AFT SEAT PAN	+224.30	+246.50	- 47.00

FIGURE A-42: -Gx TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS (FOR CELL J AND J1 TESTS)

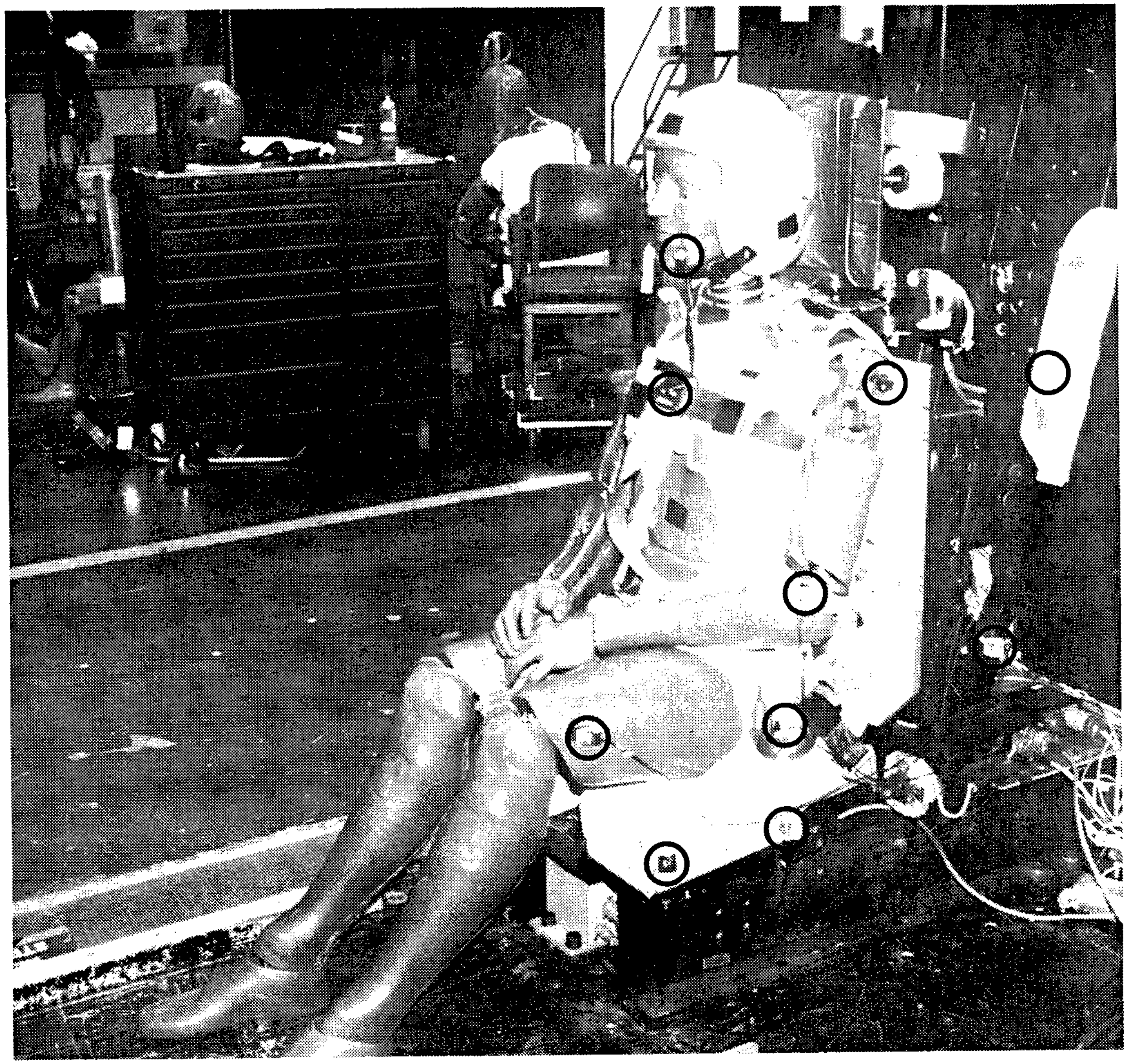
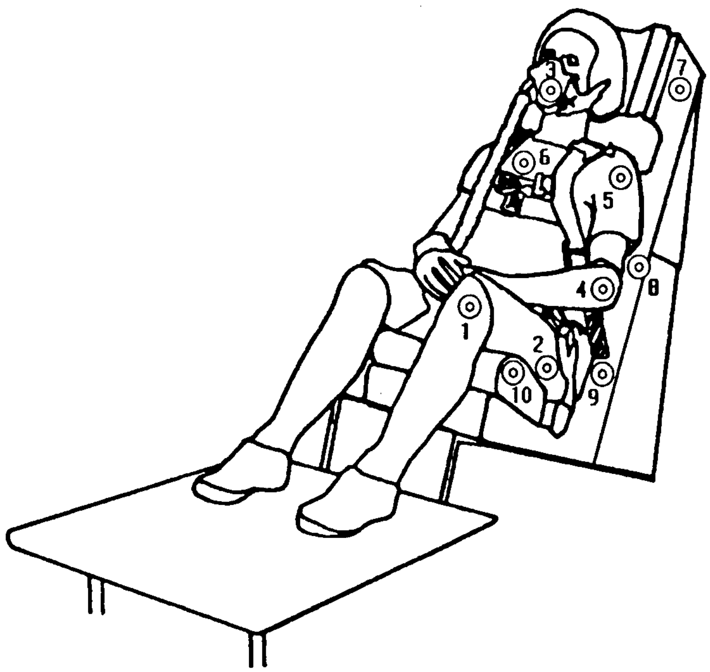


FIGURE A-43: -Gx TEST CONFIGURATION INFRARED TARGETS (FOR CELL J AND J1 TESTS)



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

	DESCRIPTION	DIMENSIONS IN MILLIMETERS		
		x	y	z
1.	KNEE	-	-	-
2.	HIP	-	-	-
3.	CHIN	-	-	-
4.	ELBOW	-	-	-
5.	SHOULDER	-	-	-
6.	CHEST	-	-	-
7.	UPPER FRAME	- 33.78	+168.30	+ 823.29
8.	SEAT BACK	- 35.35	+260.30	+ 402.38
9.	LOWER FRAME	-174.96	+175.40	+ 211.17
10.	SEAT PAN	+369.50	+244.90	- 98.21

FIGURE A-44: -Gx TEST CONFIGURATION INFRARED TARGET (LED) LOCATIONS (FOR CELL K AND L TESTS)

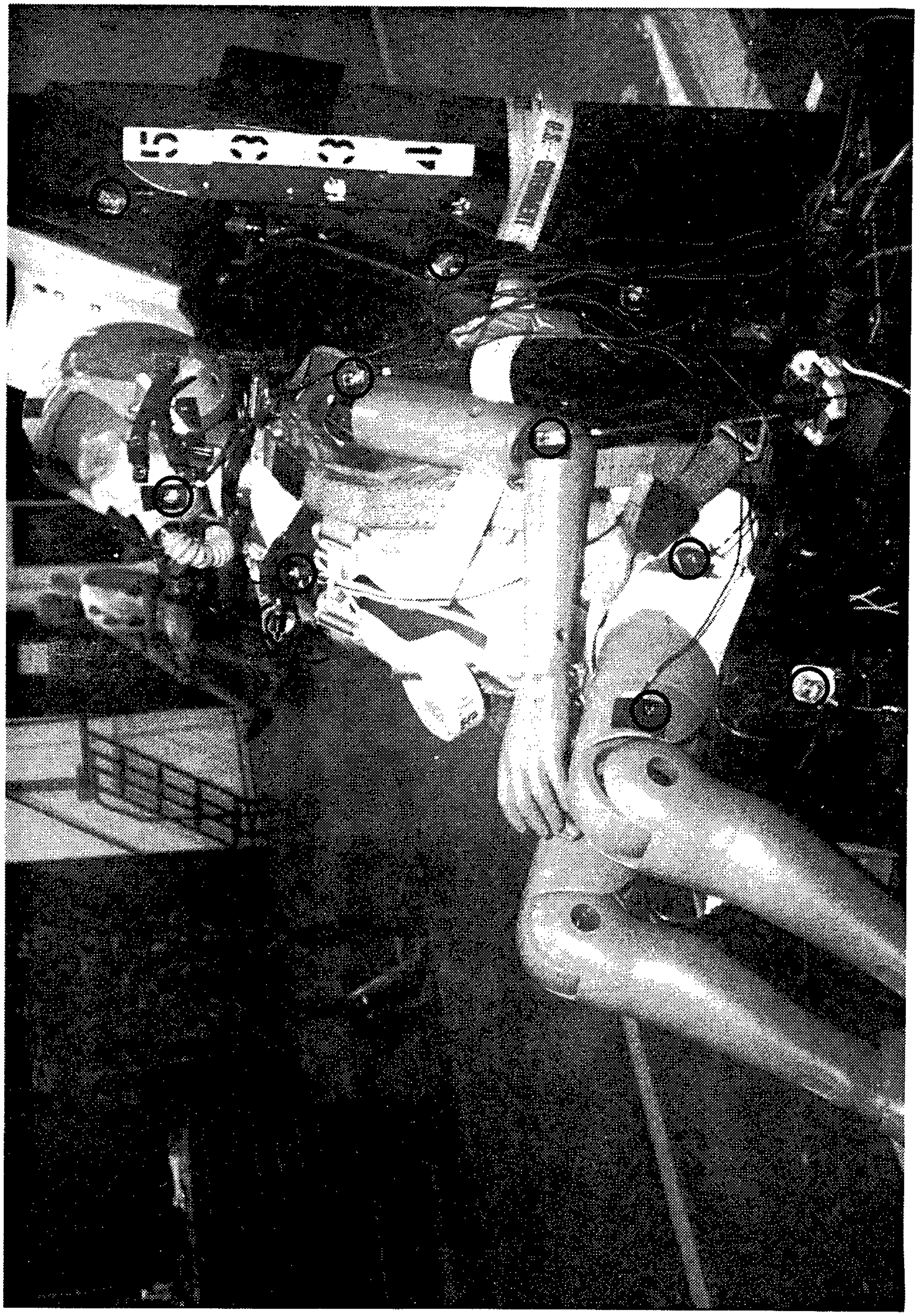


FIGURE A-45: -Gx TEST CONFIGURATION INFRARED TARGETS (FOR CELL K AND L TESTS)

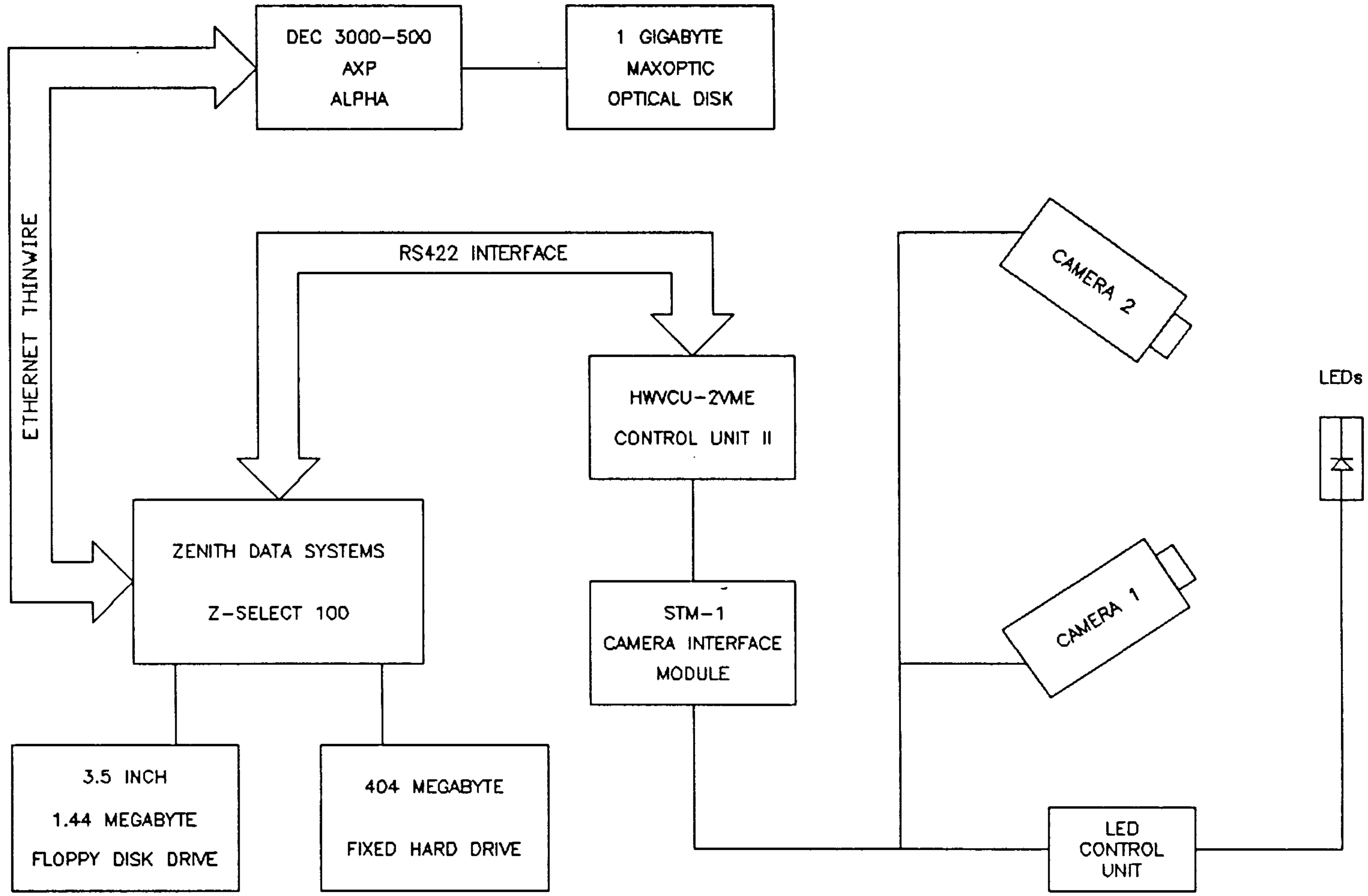


FIGURE A-46: SELSPOT MOTION ANALYSIS SYSTEM

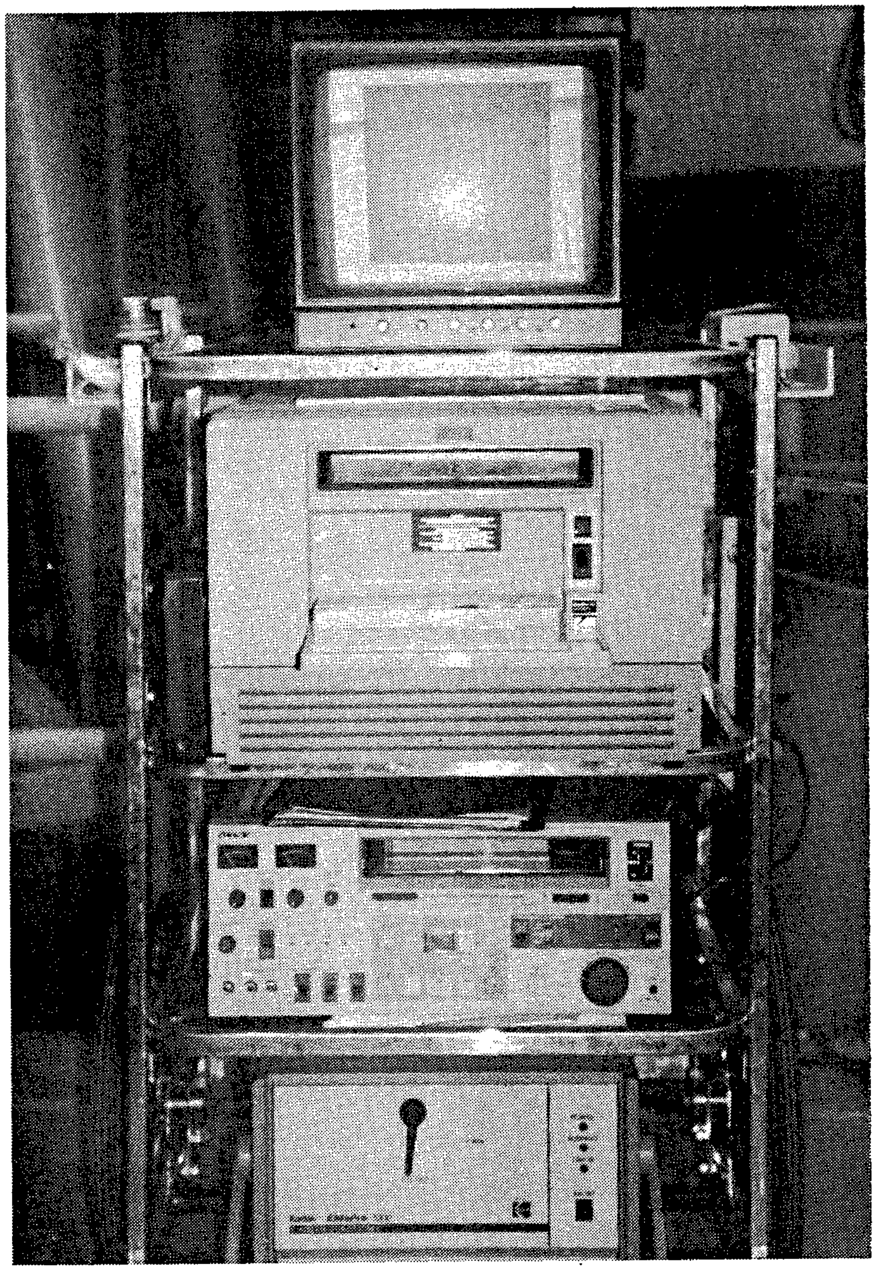
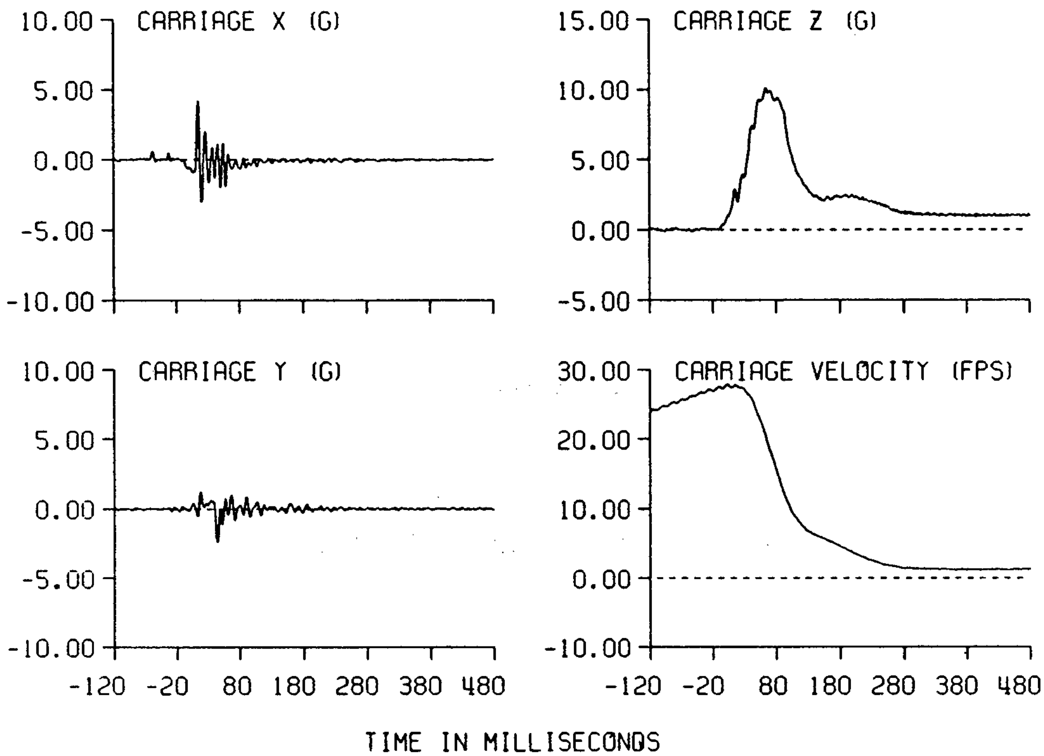


FIGURE A-47: KODAK EKTAPRO 1000 VIDEO SYSTEM

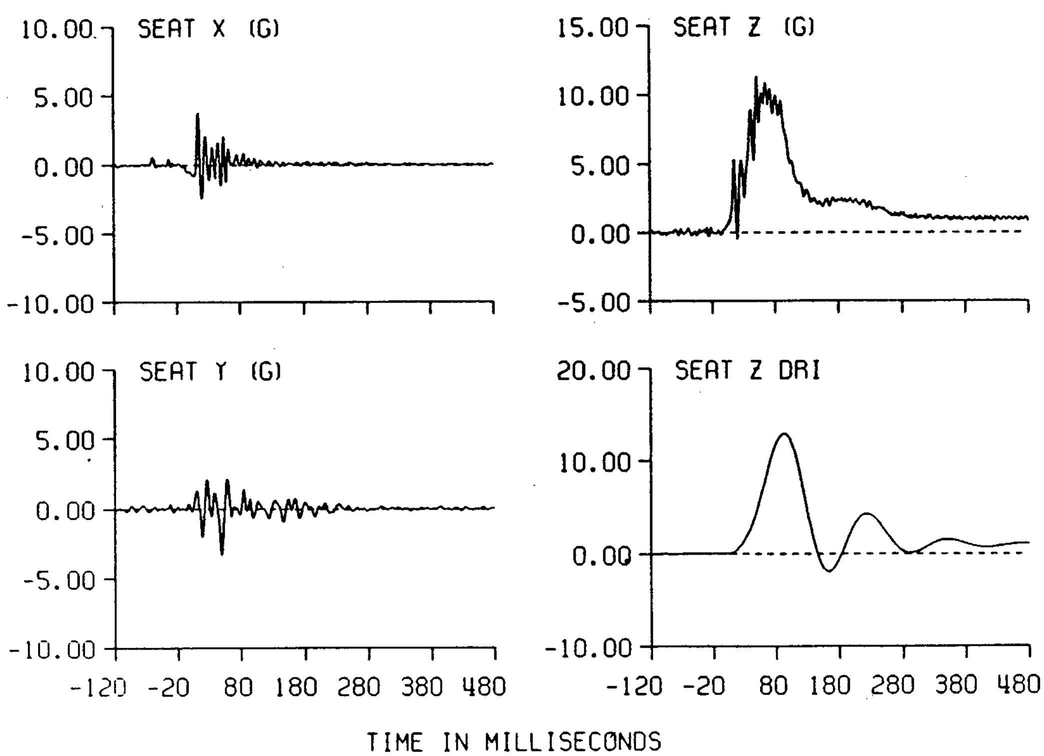
APPENDIX B

SAMPLE ACCELERATION DATA

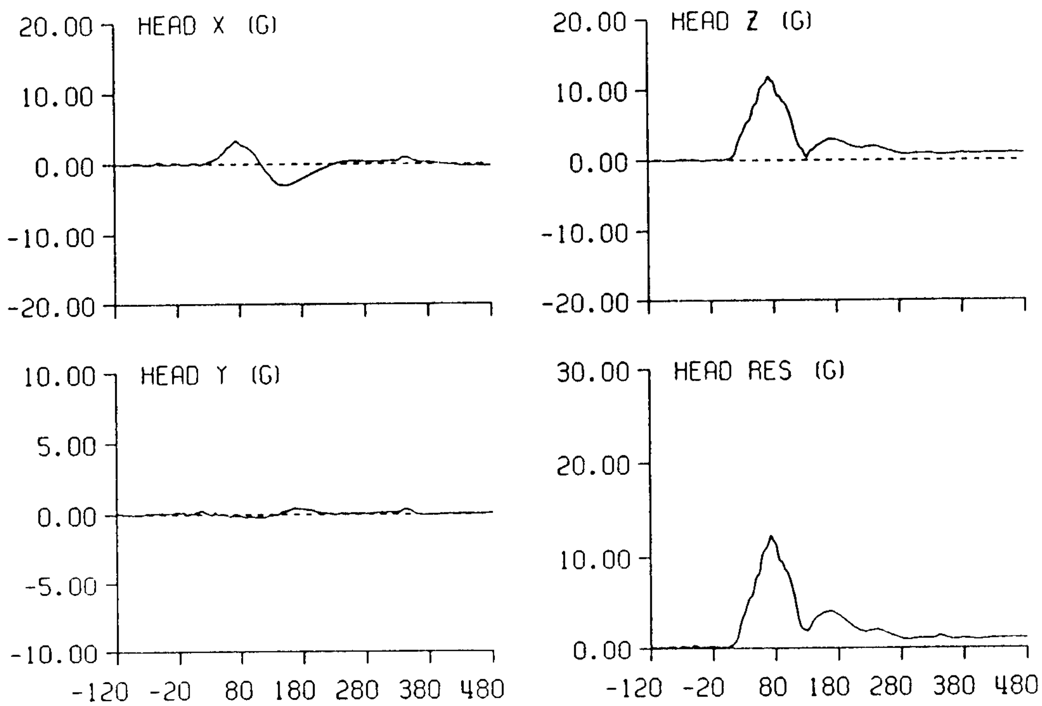
JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A



JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A

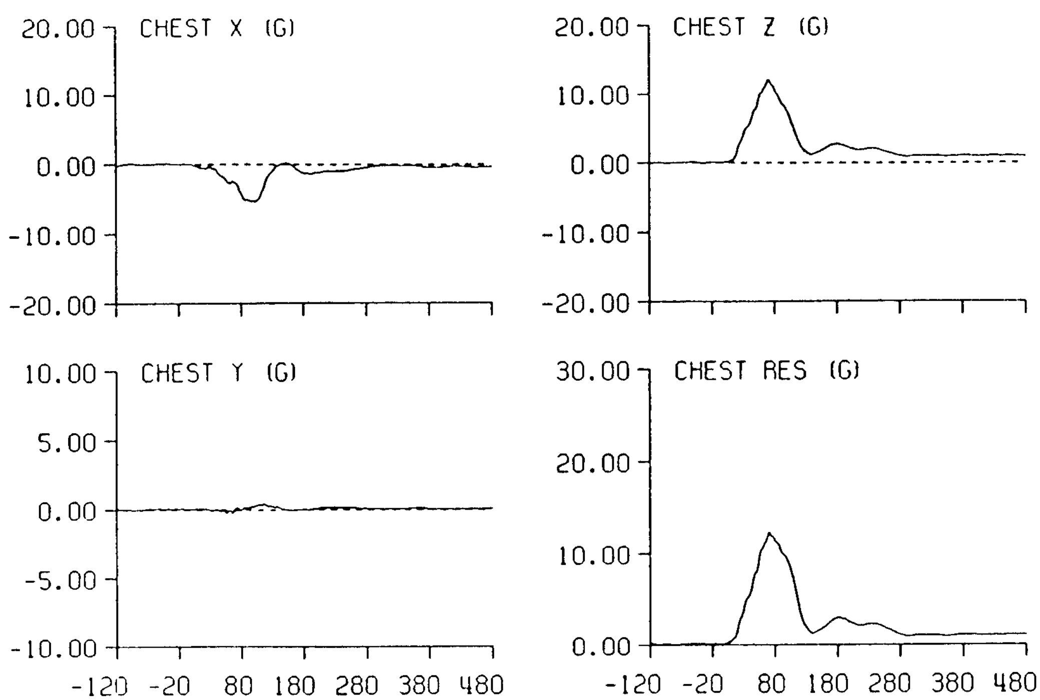


JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A



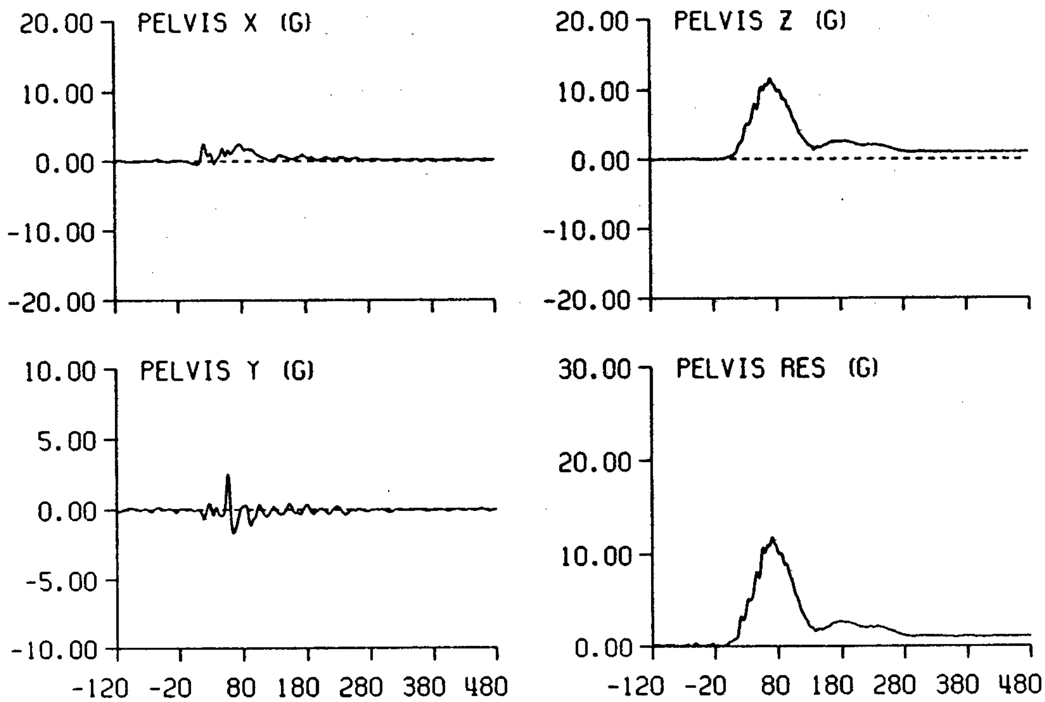
TIME IN MILLISECONDS

JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A



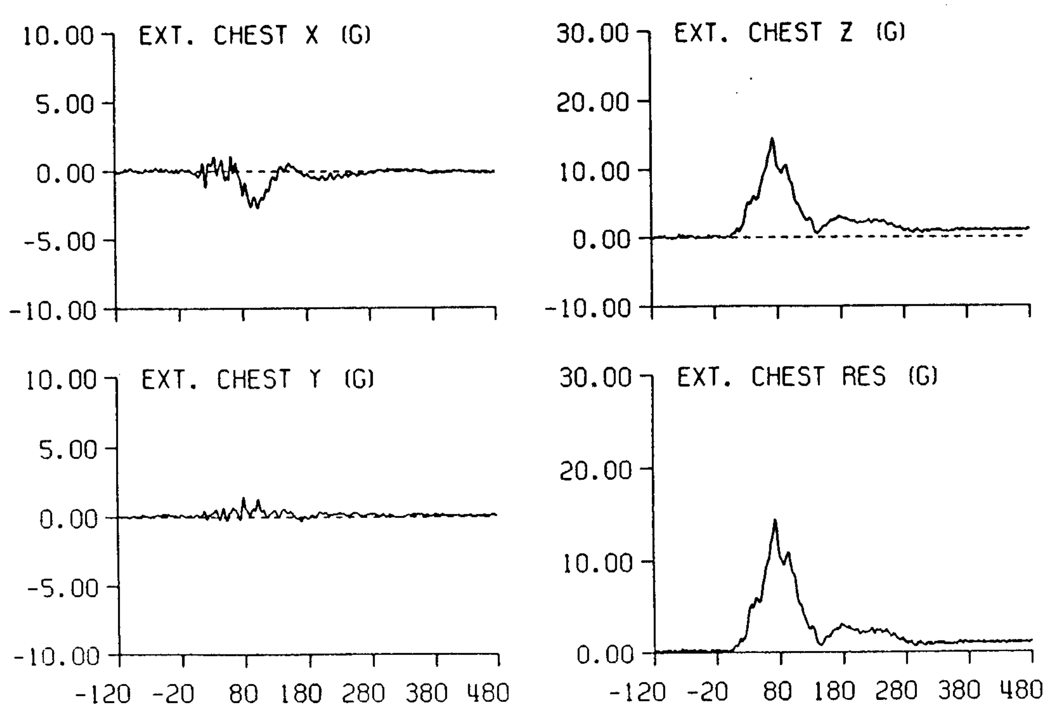
TIME IN MILLISECONDS

JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A

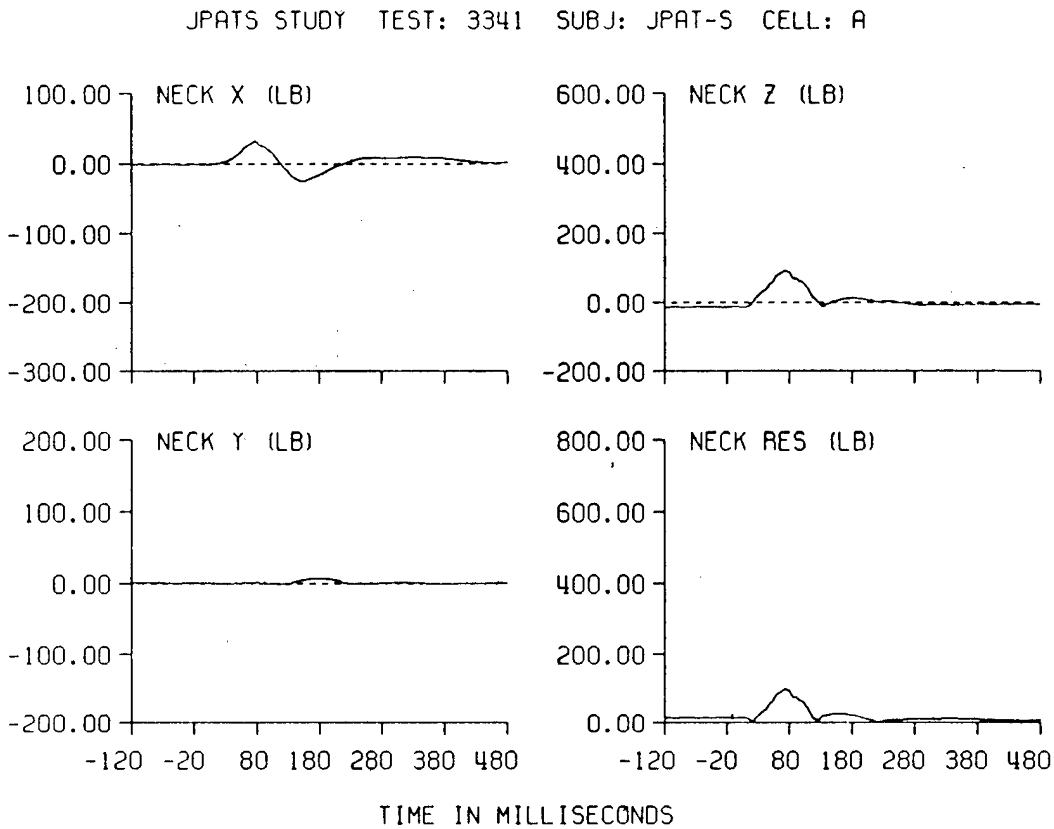


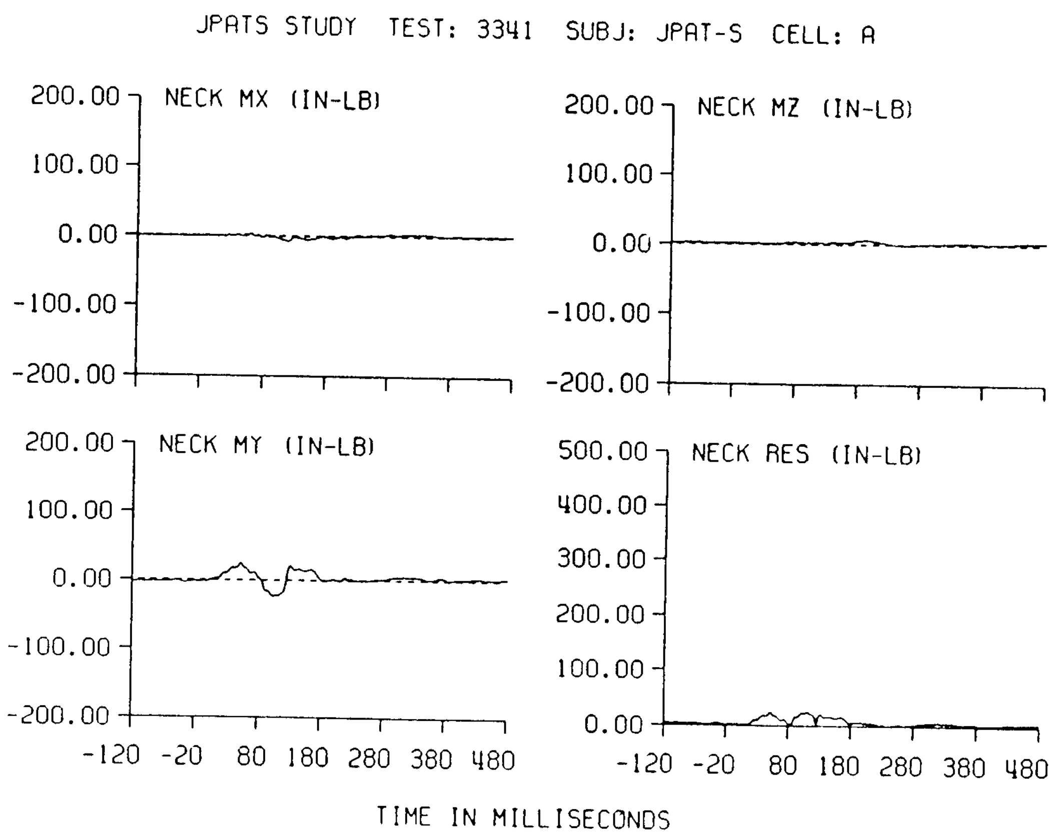
TIME IN MILLISECONDS

JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A

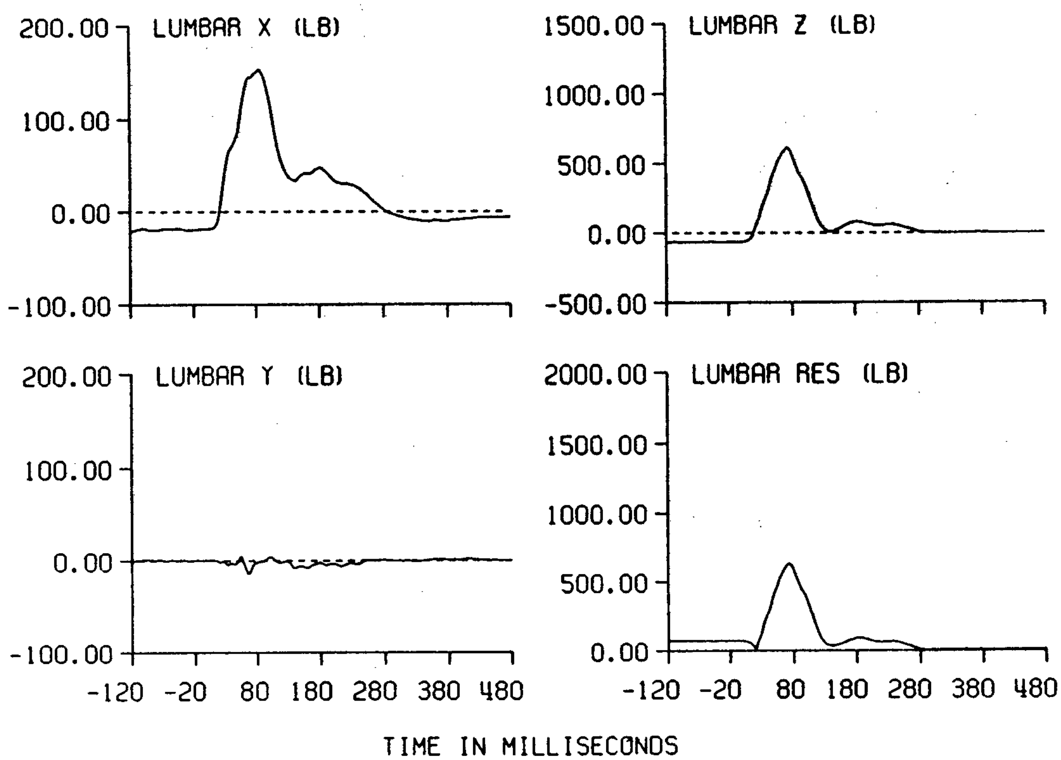


TIME IN MILLISECONDS

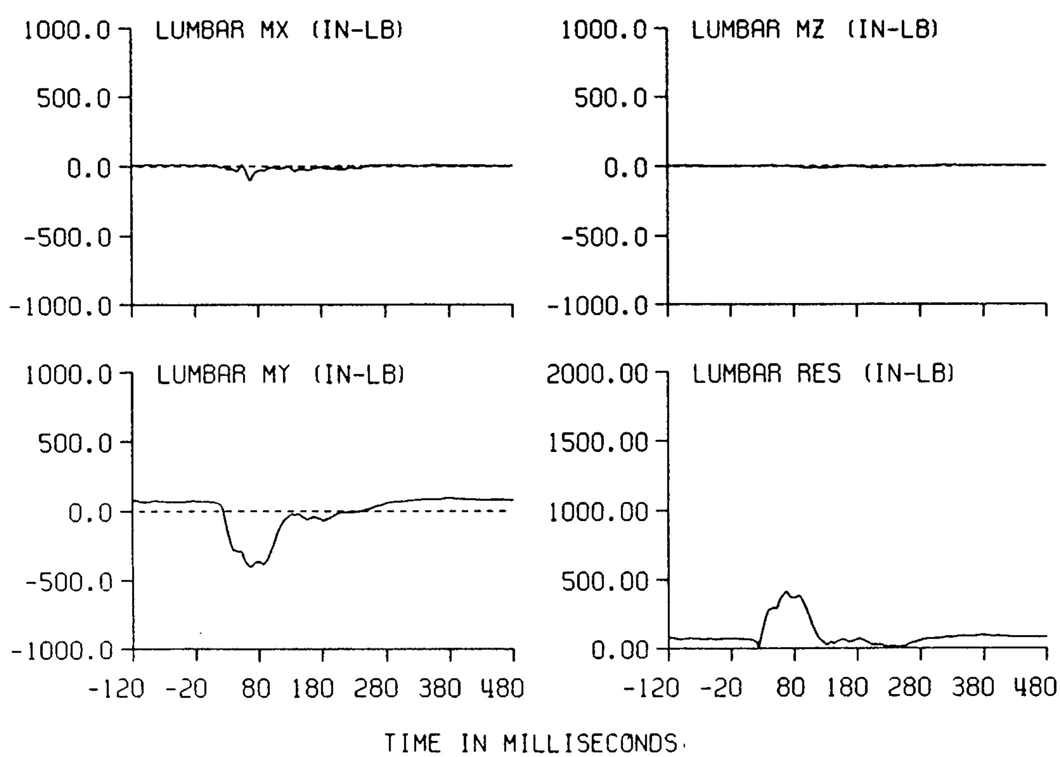

JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-120 -20 80 180 280 380 480
TIME IN MILLISECONDS

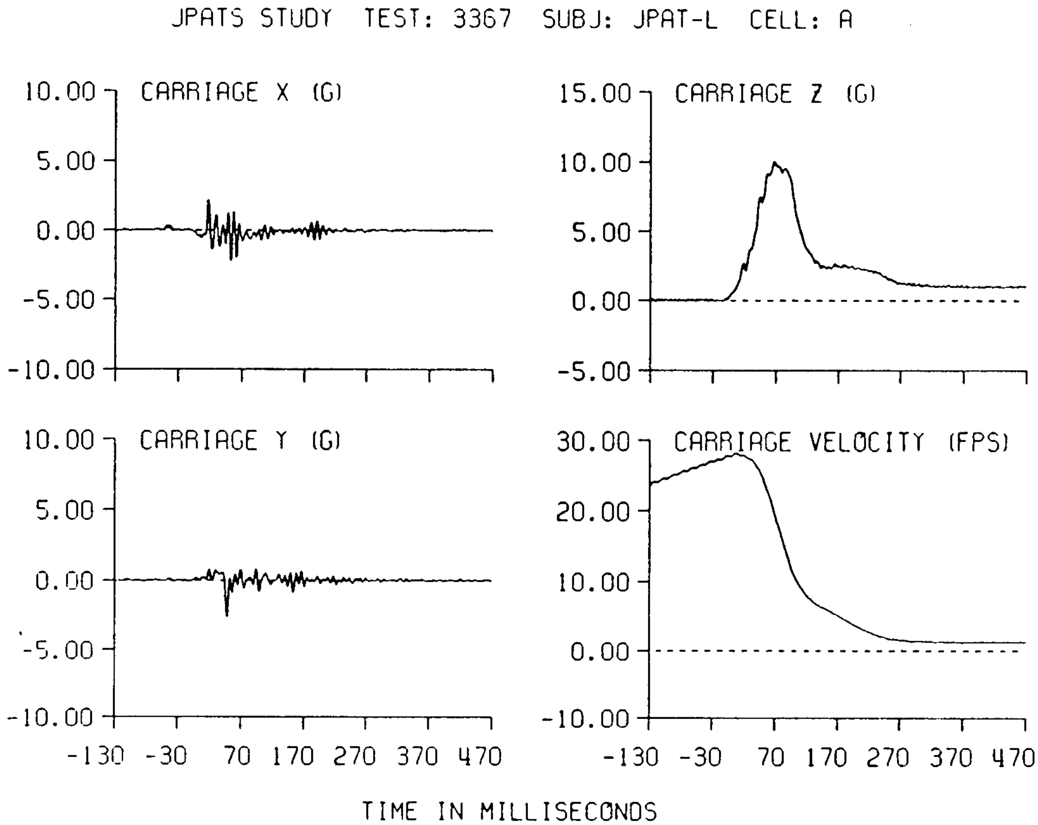

JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
500.00
400.00
300.00
200.00
100.00
0.00
-120 -20 80 180 280 380 480
TIME IN MILLISECONDS

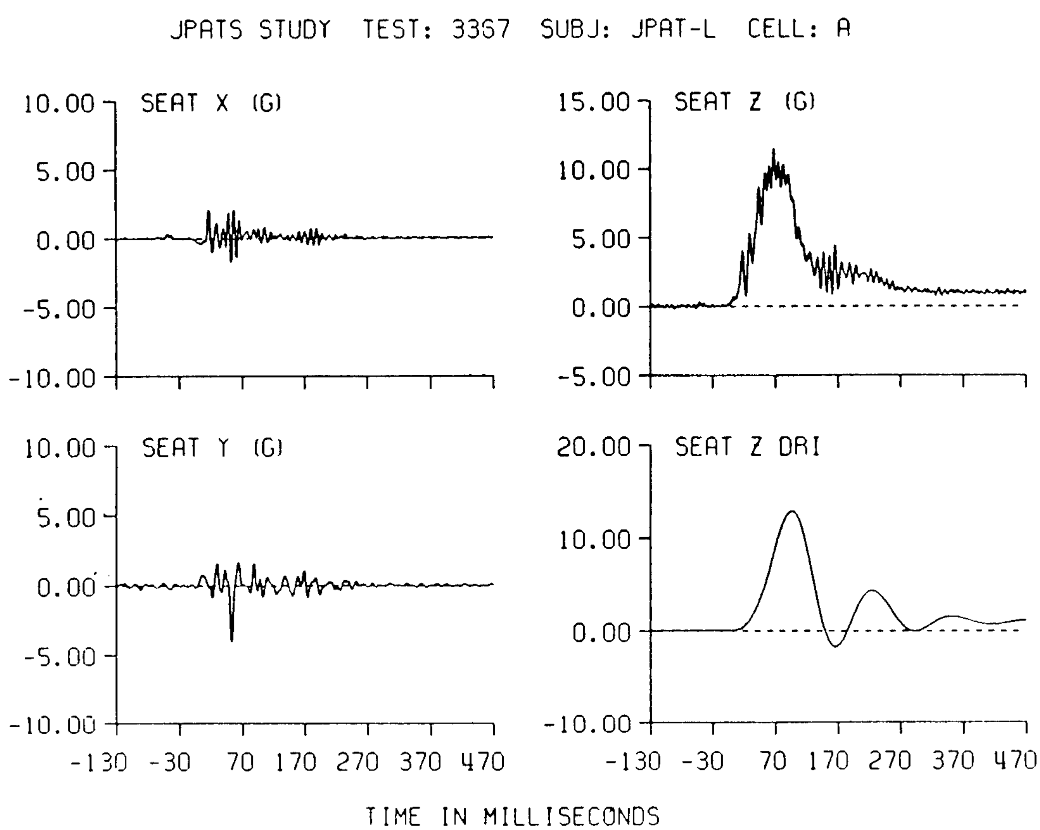
JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A



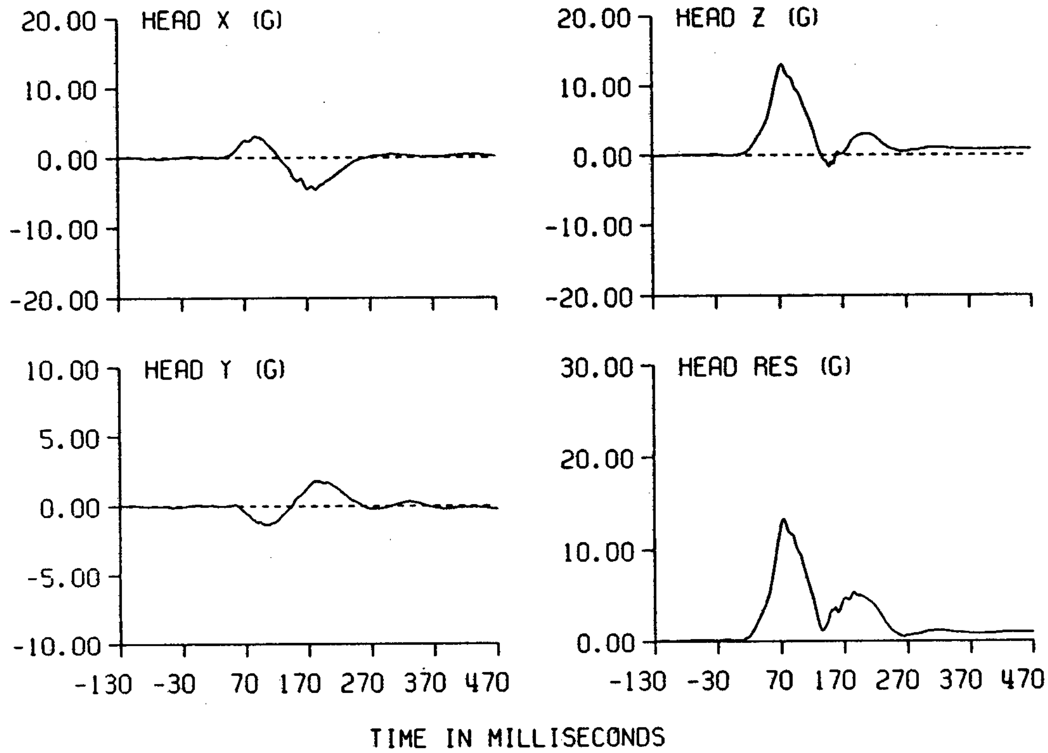
JPATS STUDY TEST: 3341 SUBJ: JPAT-S CELL: A



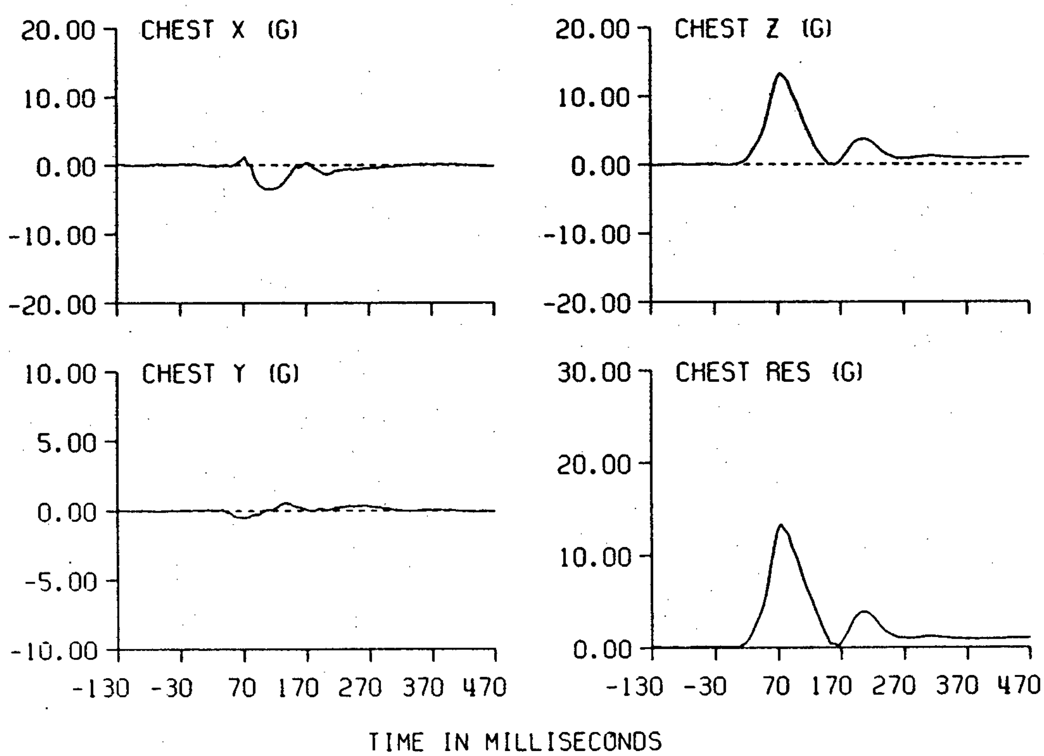

JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A
CARRIAGE X (G)
CARRIAGE Z (G)
CARRIAGE Y (G)
CARRIAGE VELOCITY (FPS)
TIME IN MILLISECONDS

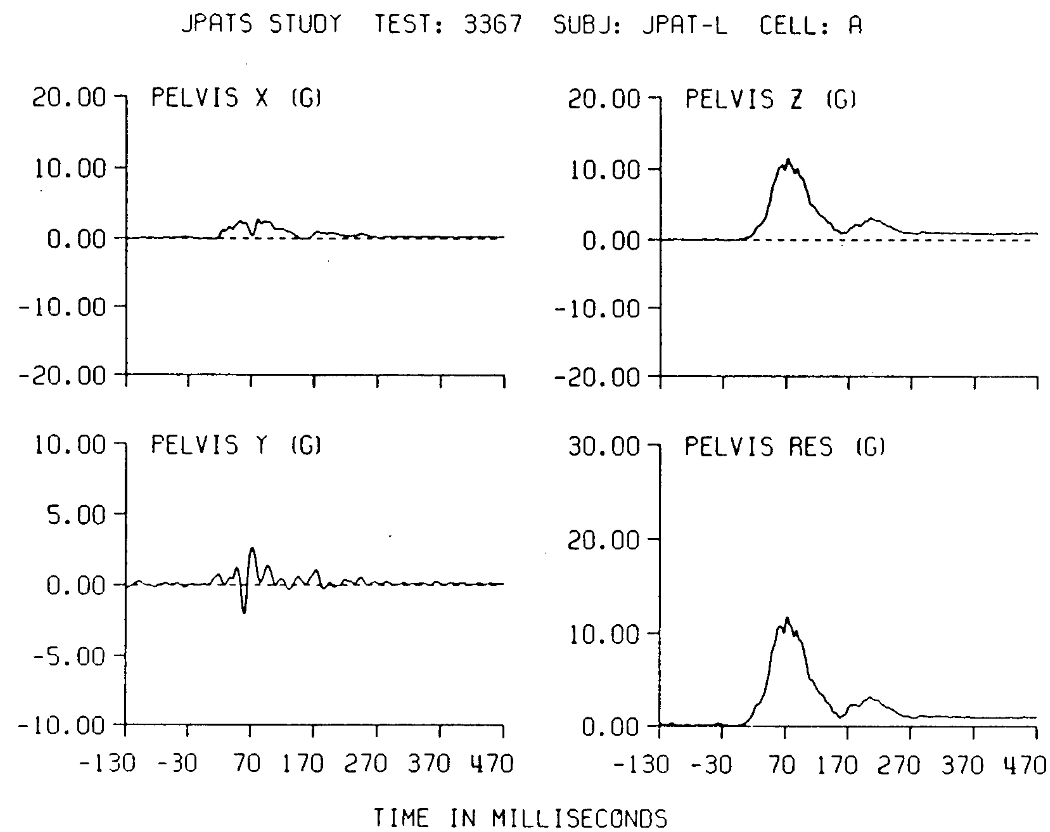

JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A
SEAT X (G)
SEAT Z (G)
SEAT Y (G)
SEAT Z DRI
TIME IN MILLISECONDS

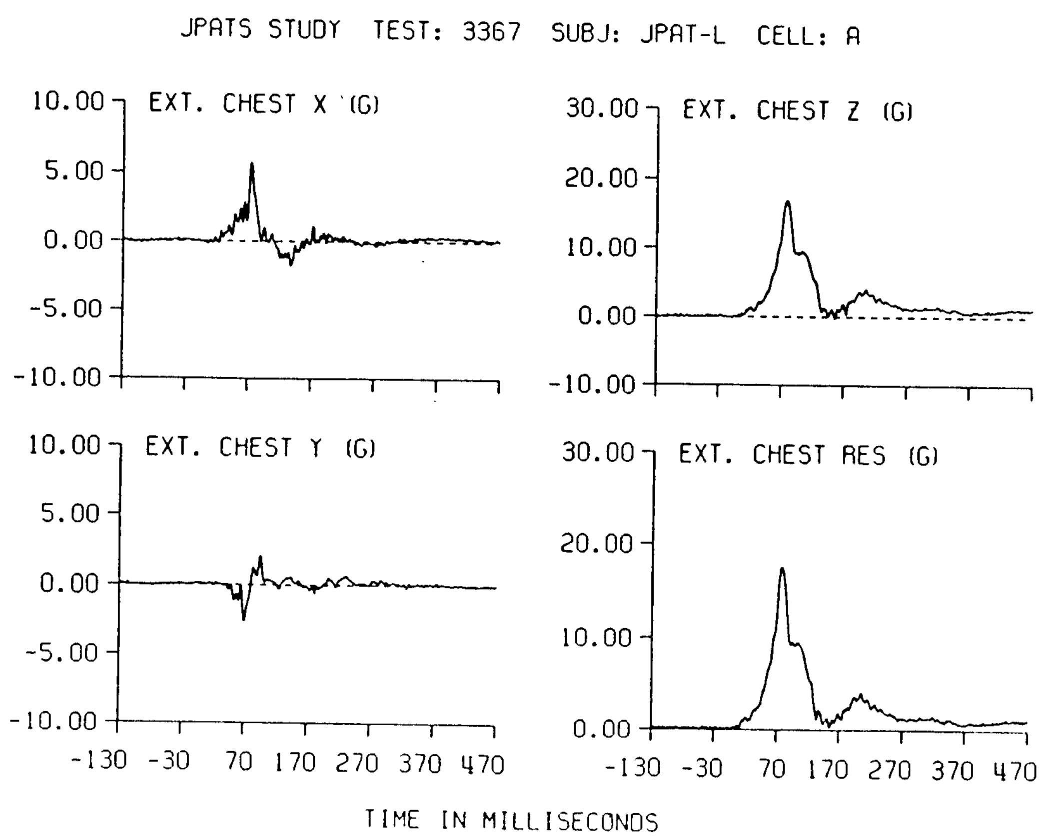
JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A



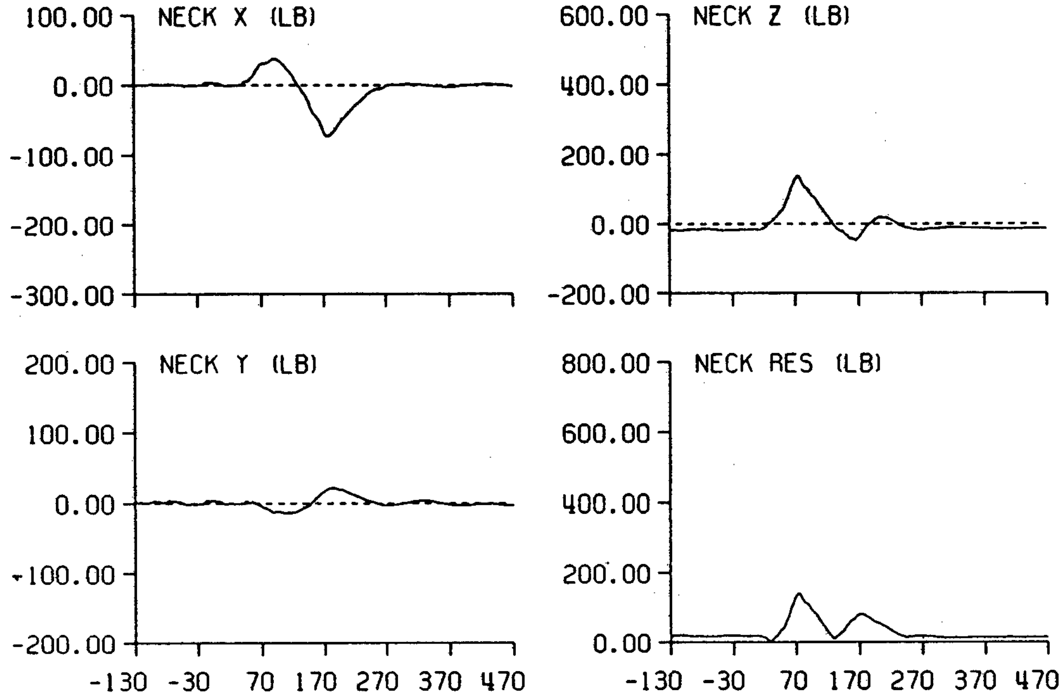
JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A




JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A
PELVIS X (G)
PELVIS Z (G)
PELVIS Y (G)
PELVIS RES (G)
20.00
10.00
0.00
-10.00
-20.00
5.00
-5.00
30.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

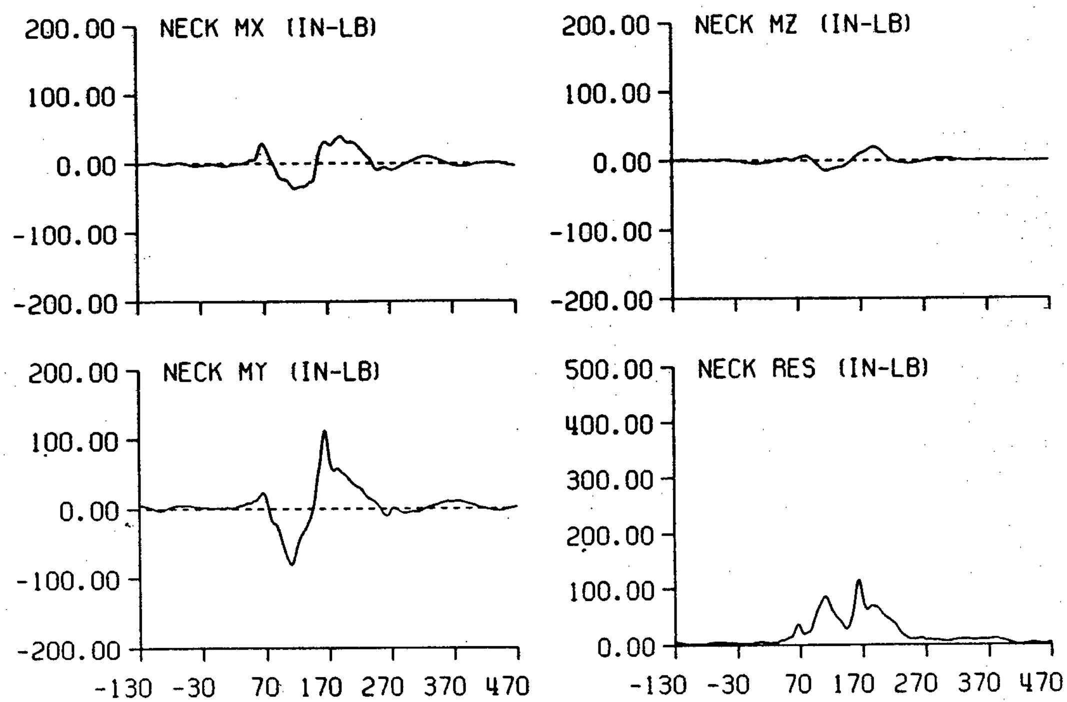

JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A
EXT. CHEST X (G)
EXT. CHEST Z (G)
EXT. CHEST Y (G)
EXT. CHEST RES (G)
10.00
5.00
0.00
-5.00
-10.00
30.00
20.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A



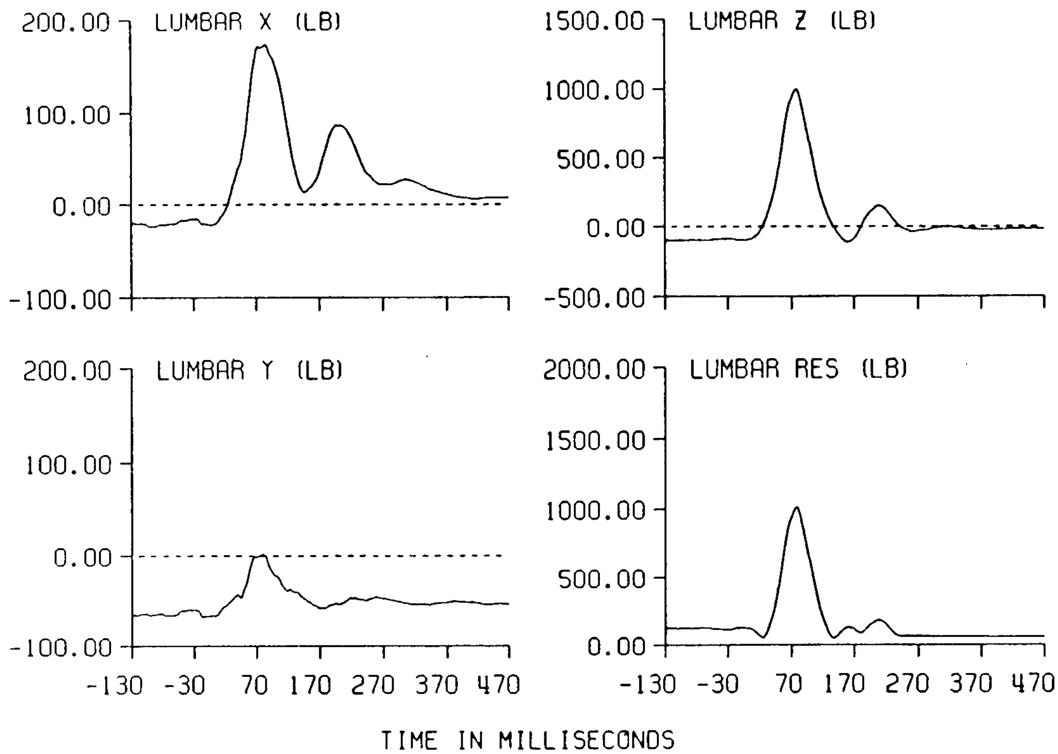
TIME IN MILLISECONDS

JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A

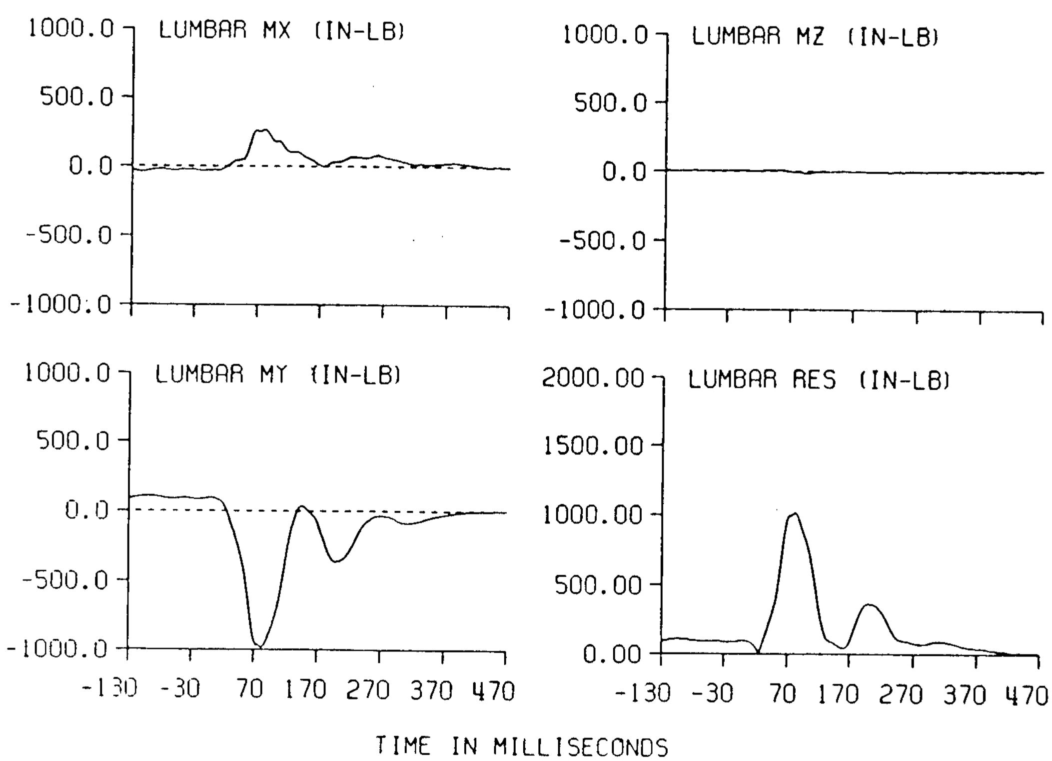


TIME IN MILLISECONDS

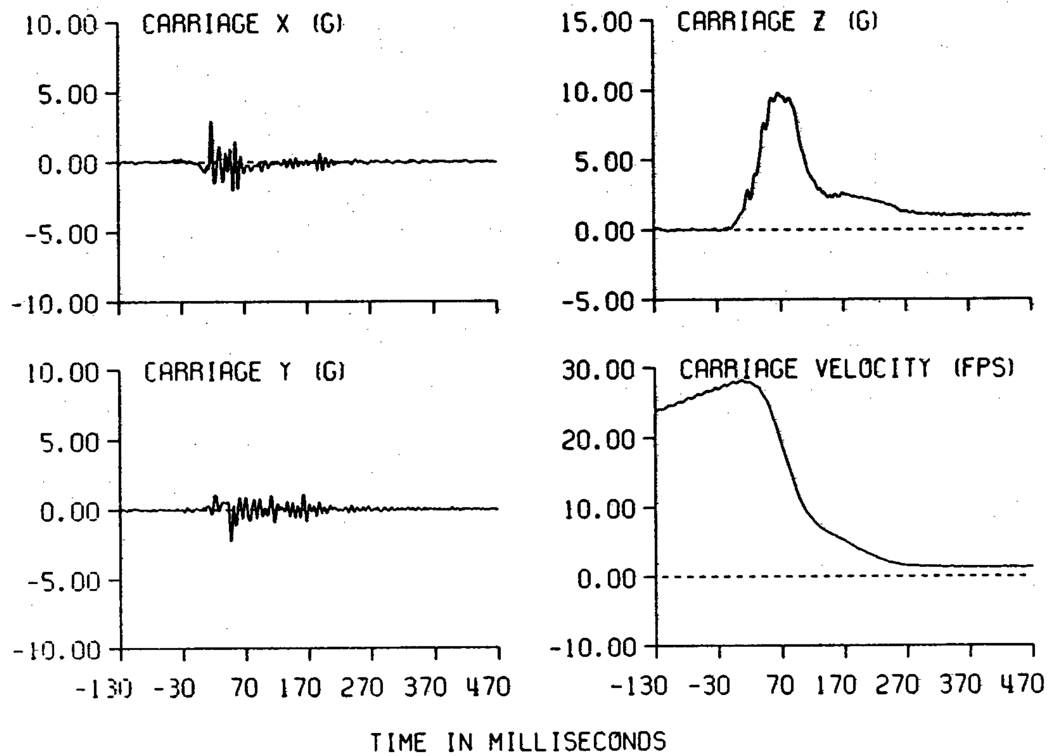
JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A



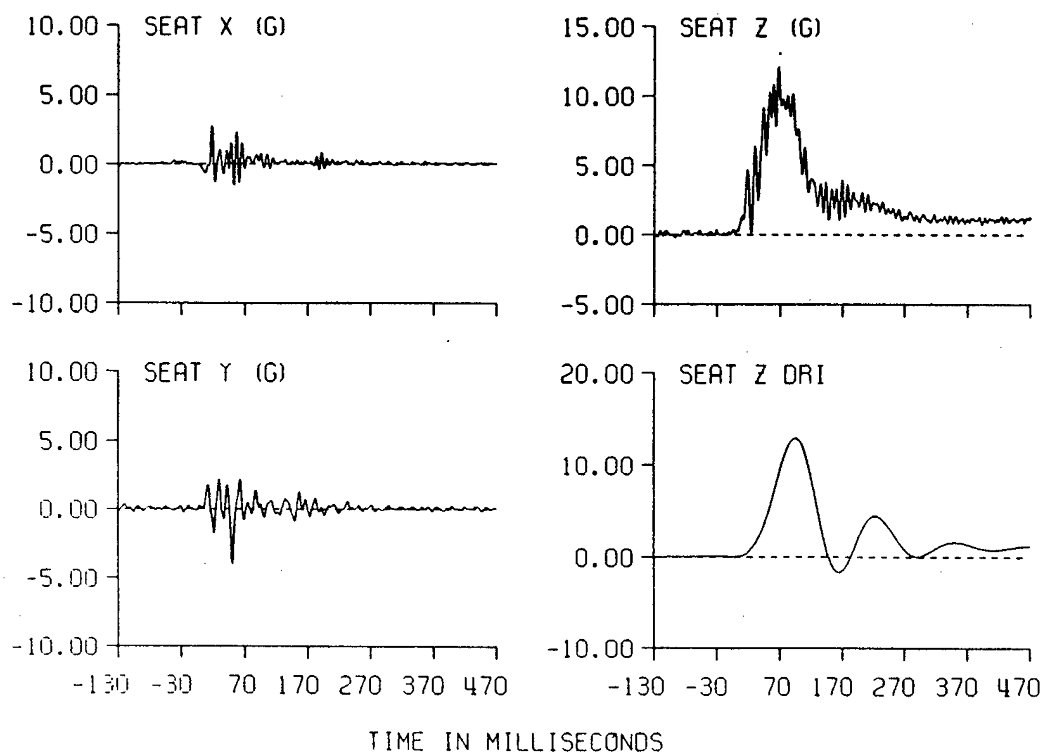
JPATS STUDY TEST: 3367 SUBJ: JPAT-L CELL: A



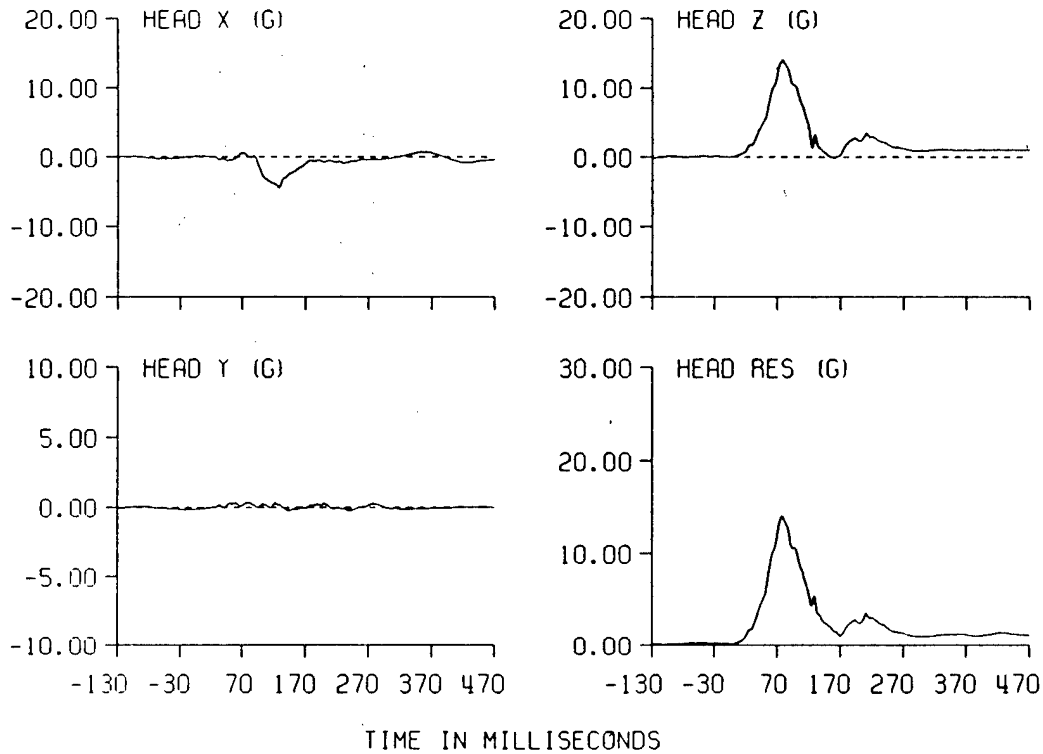
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



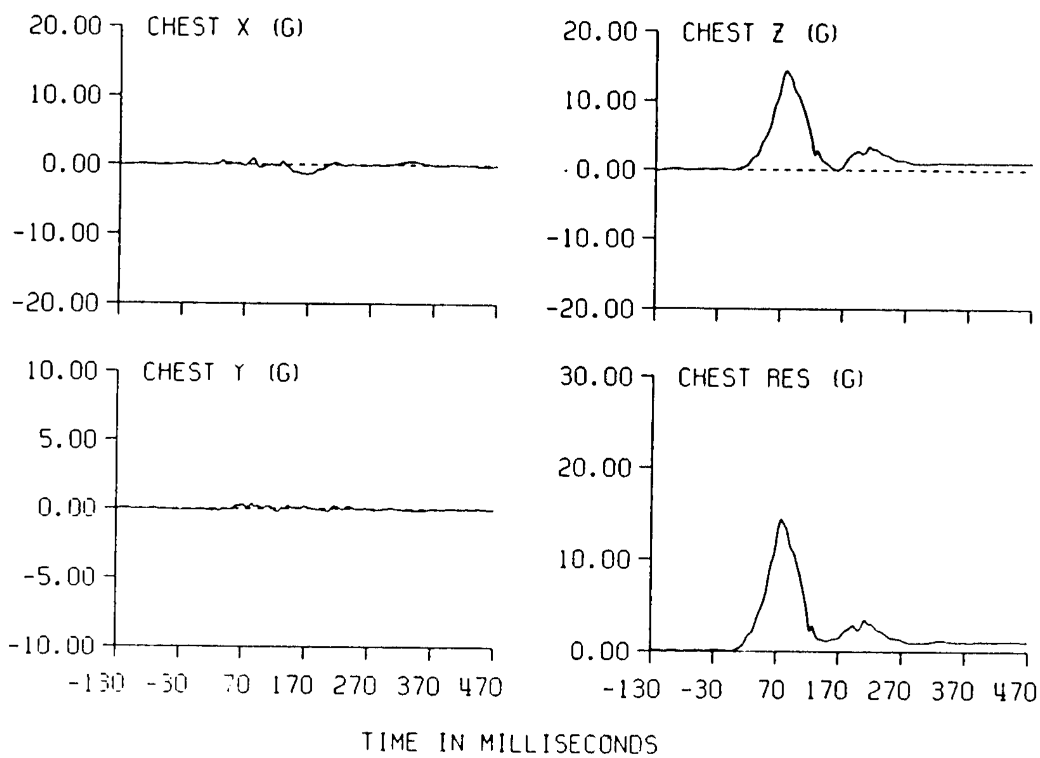
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



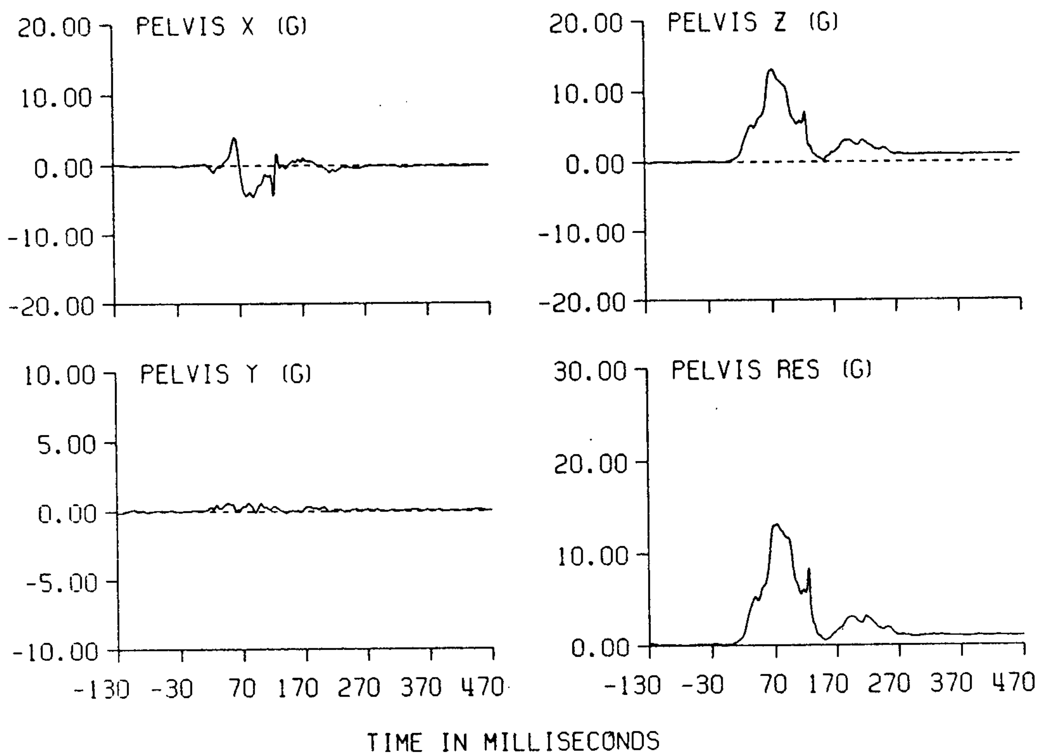
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



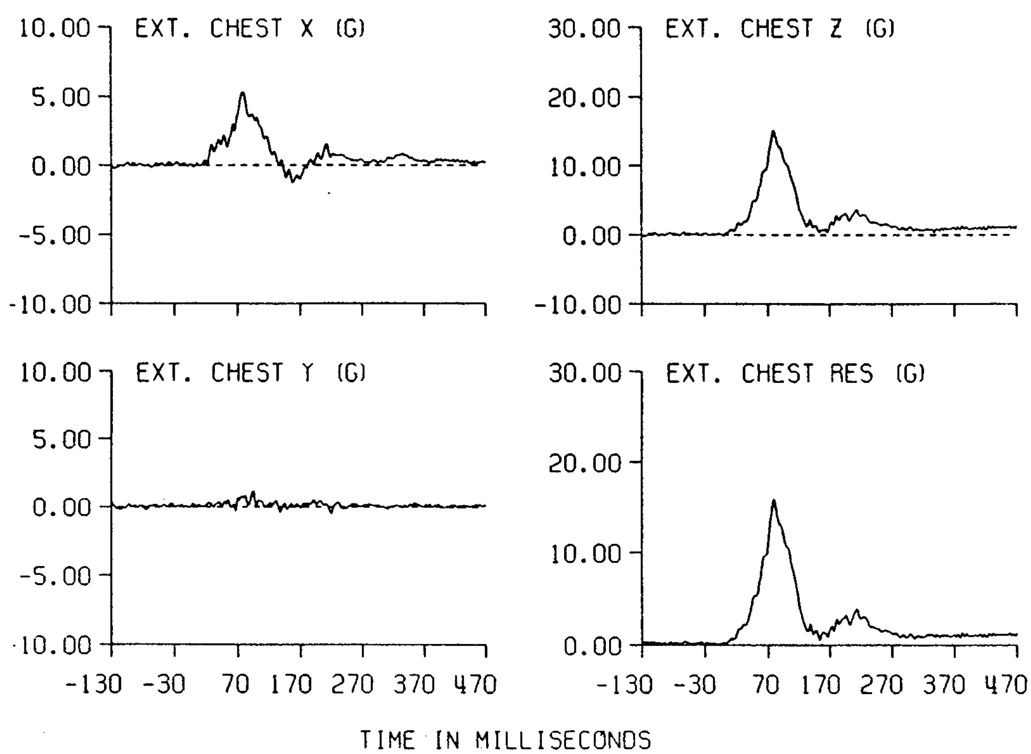
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A

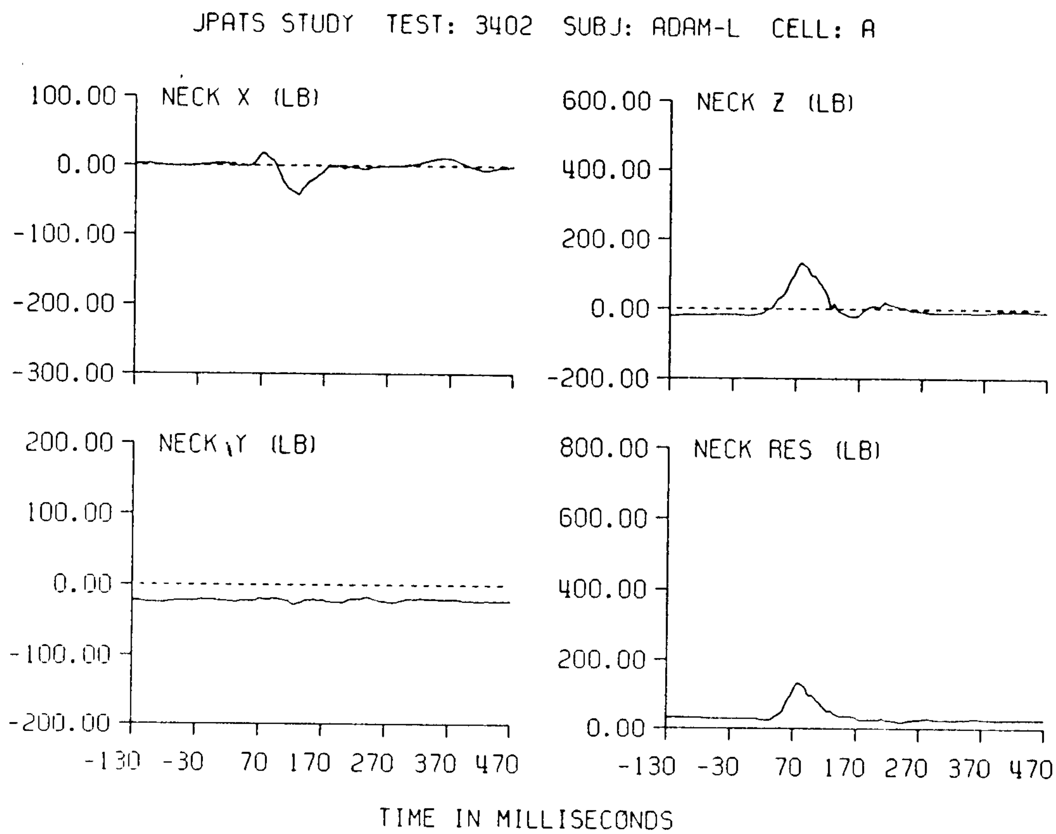


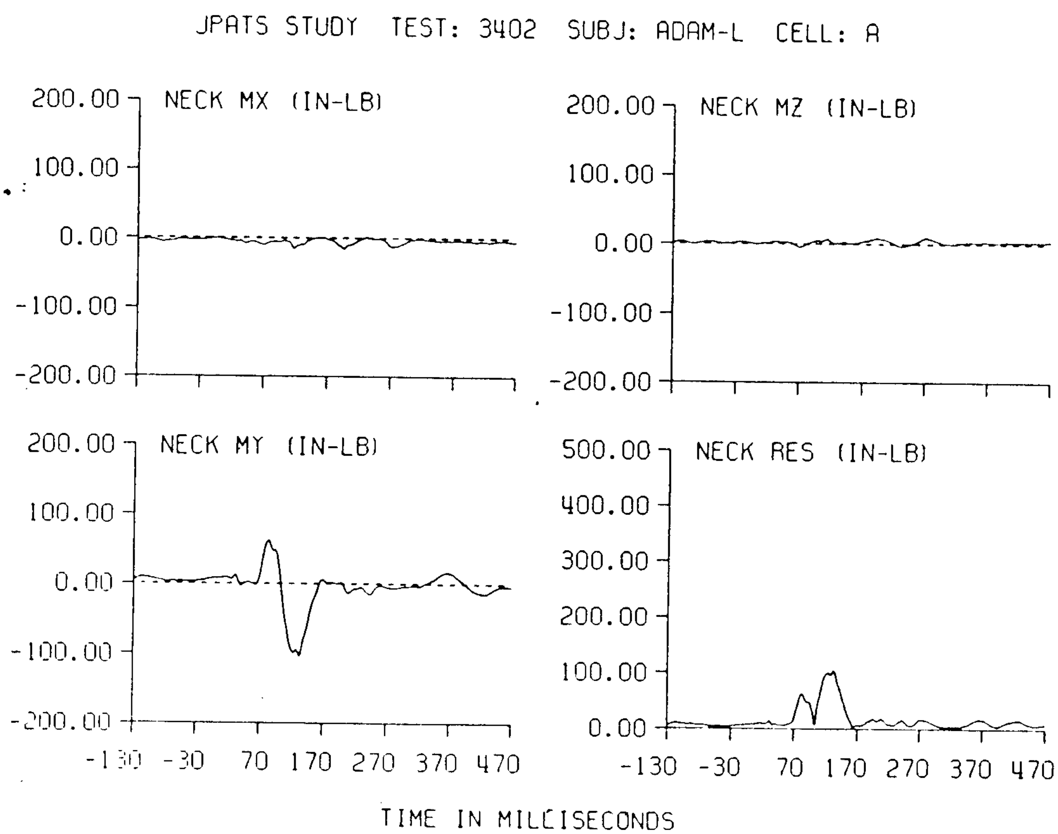
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



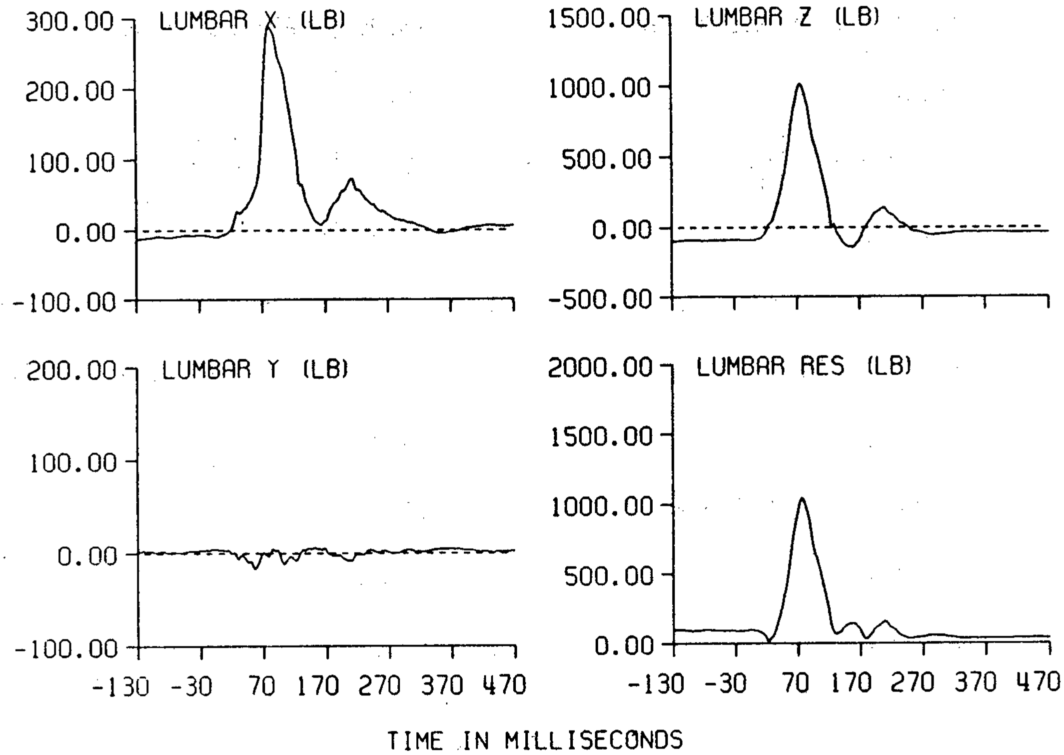
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



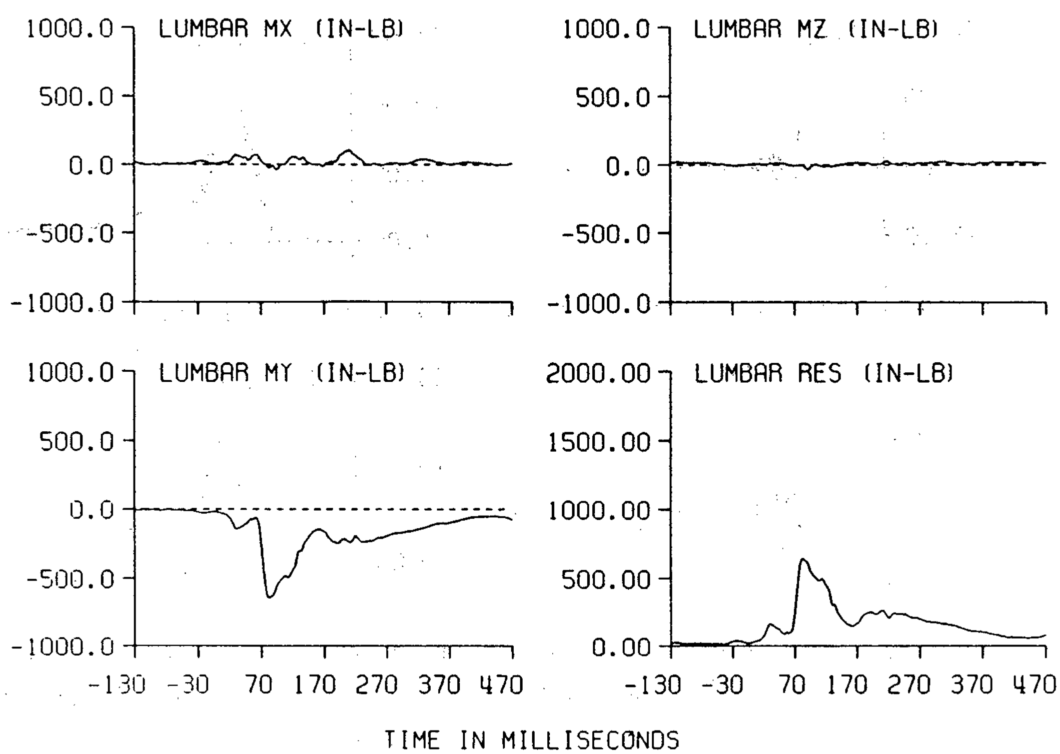

JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A
NECK X (LB)
100.00
0.00
-100.00
-200.00
-300.00
NECK Z (LB)
600.00
400.00
200.00
0.00
-200.00
NECK Y (LB)
200.00
100.00
0.00
-100.00
-200.00
NECK RES (LB)
800.00
600.00
400.00
200.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS


JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A
NECK MX (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
NECK MZ (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
NECK MY (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
NECK RES (IN-LB)
500.00
400.00
300.00
200.00
100.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

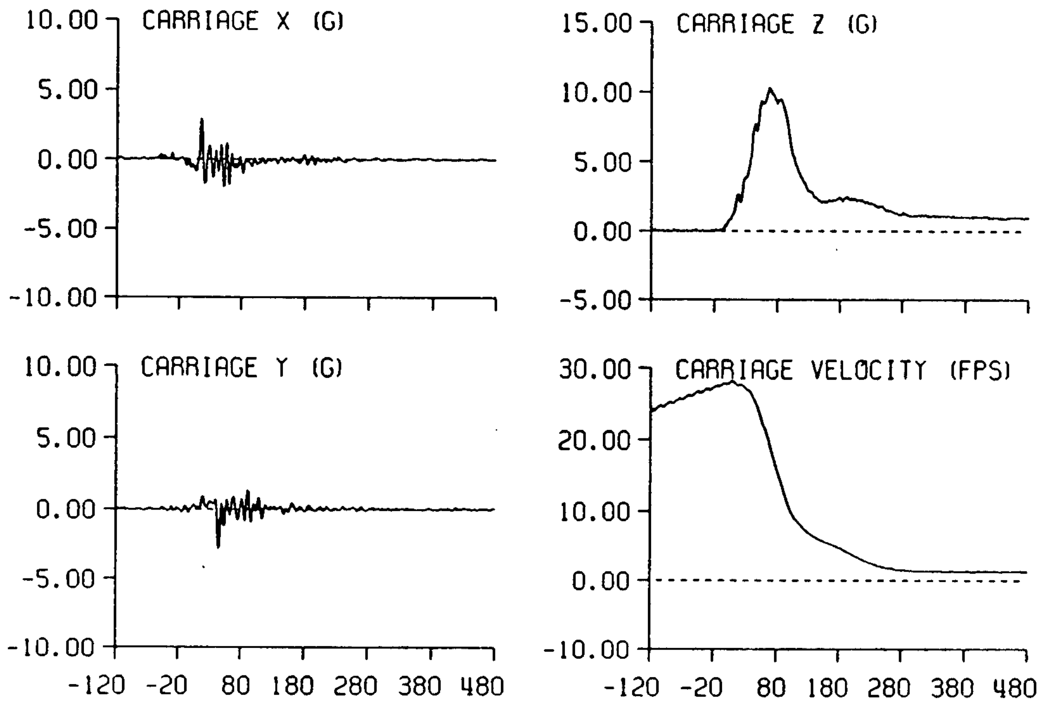
JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A



JPATS STUDY TEST: 3402 SUBJ: ADAM-L CELL: A

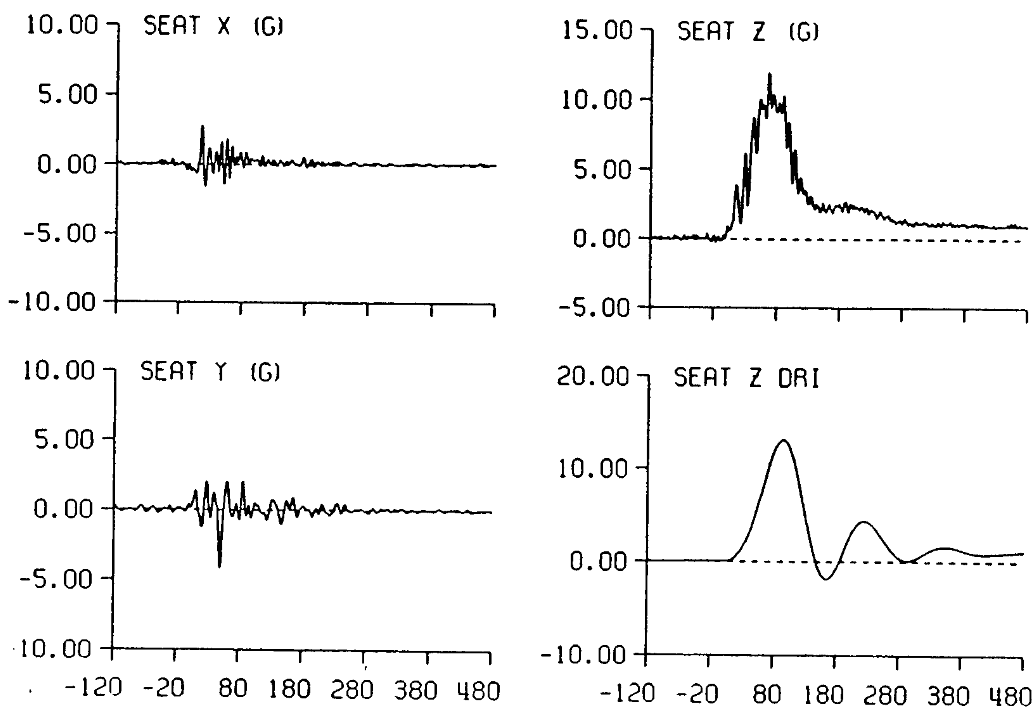


JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



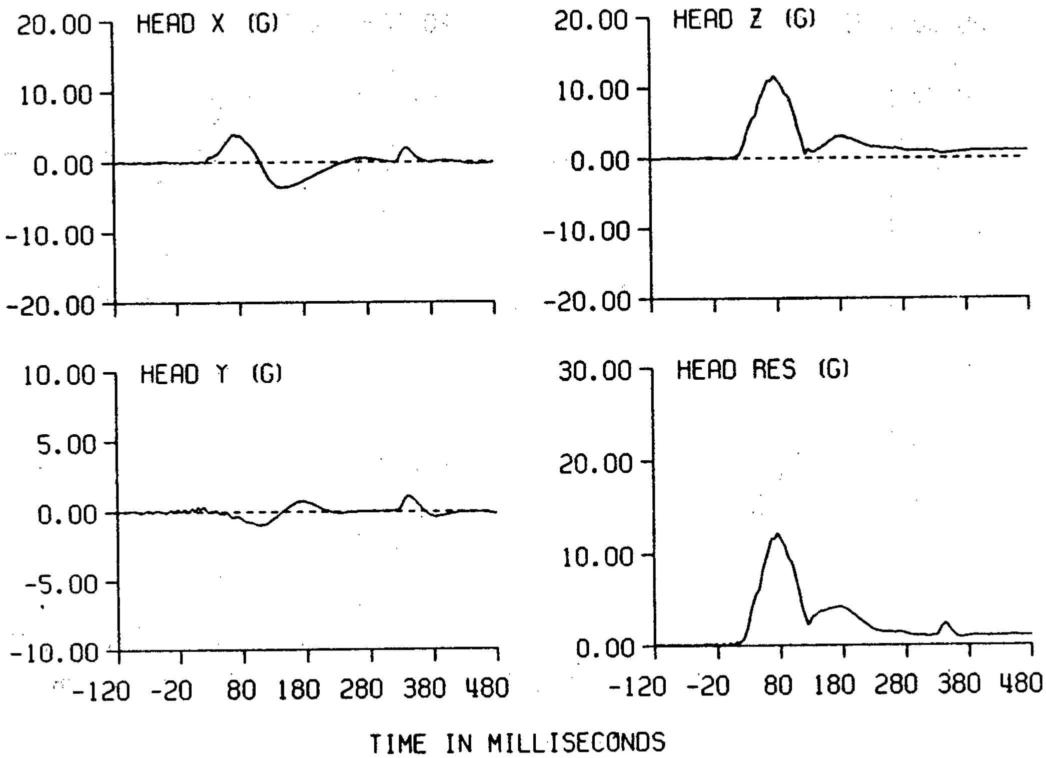
TIME IN MILLISECONDS

JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B

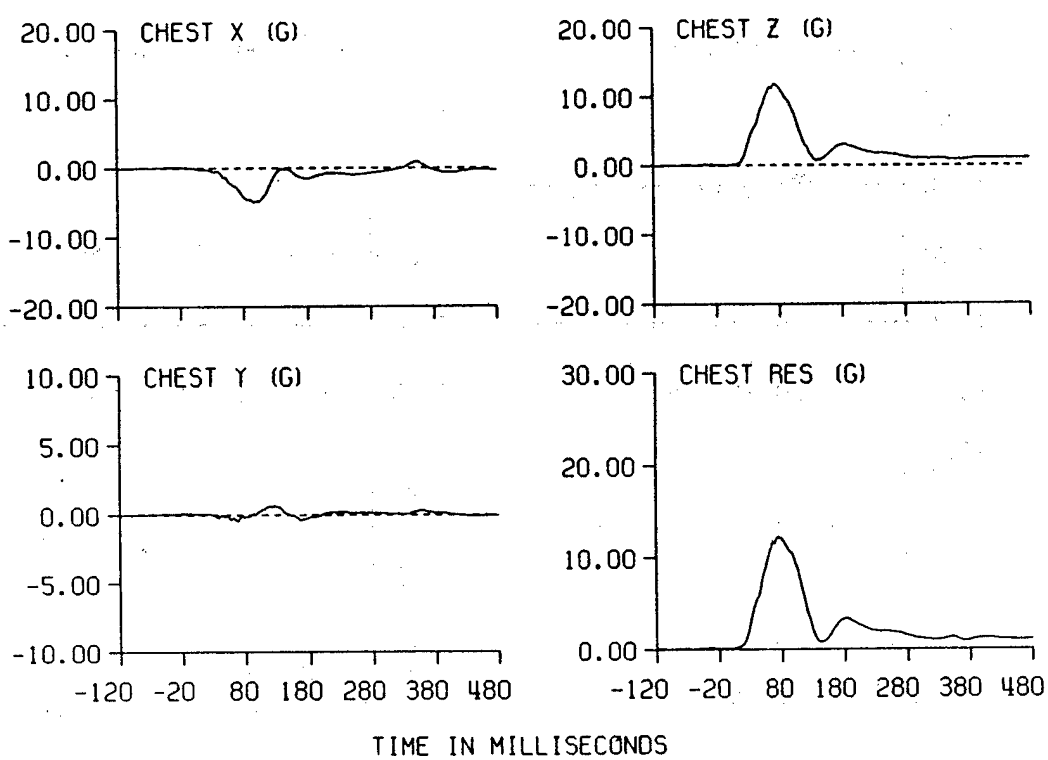


TIME IN MILLISECONDS

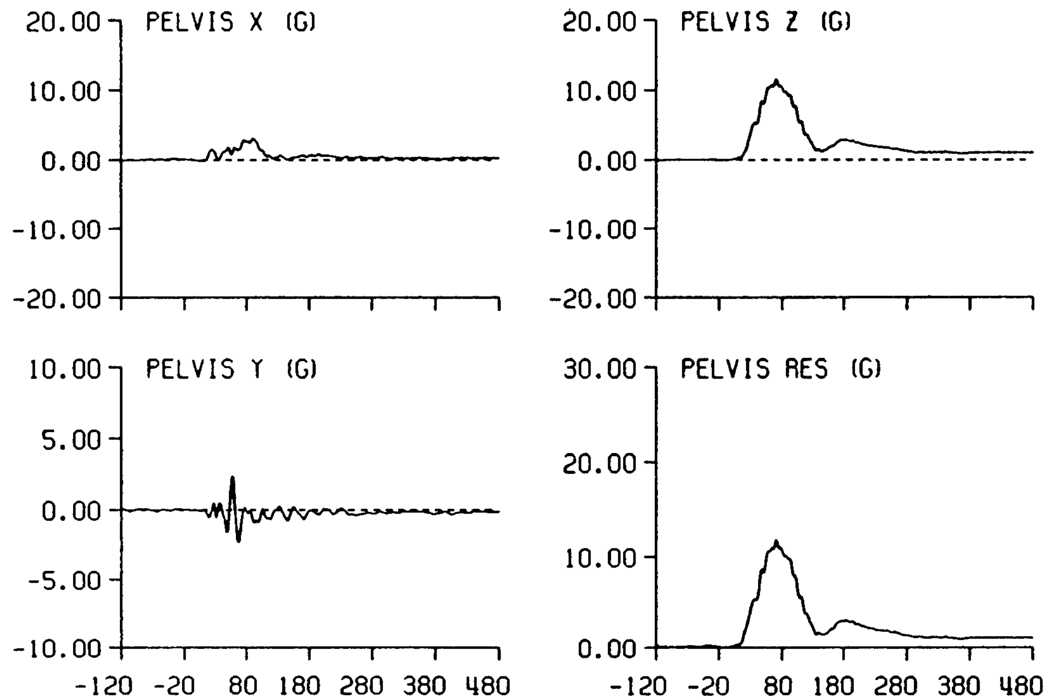
JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B

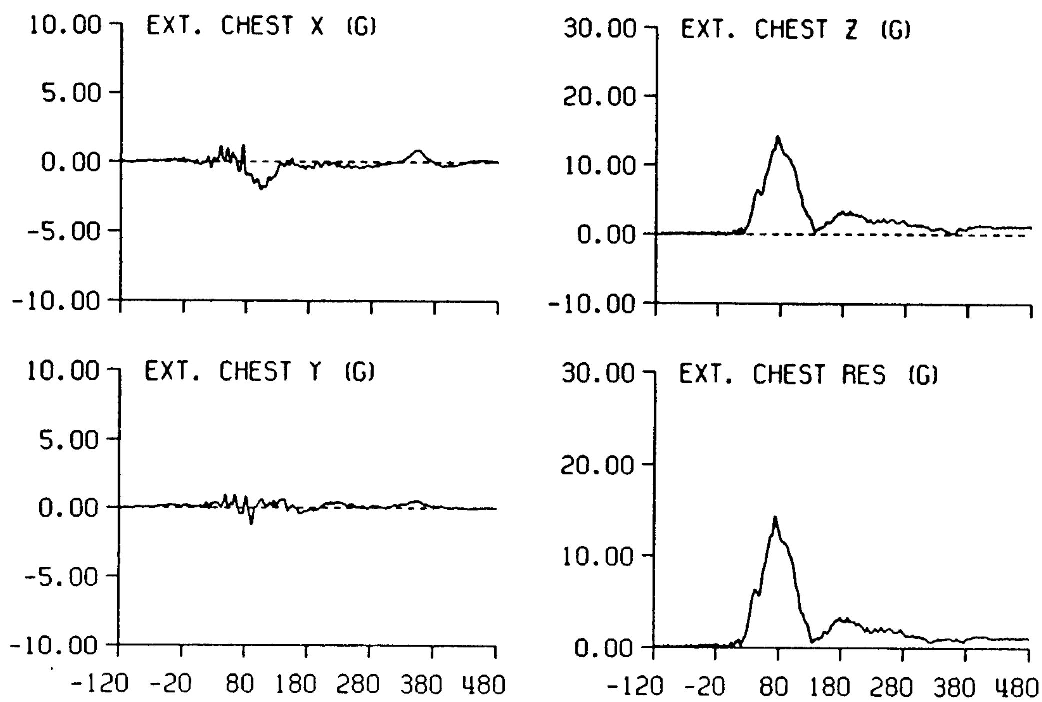


JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



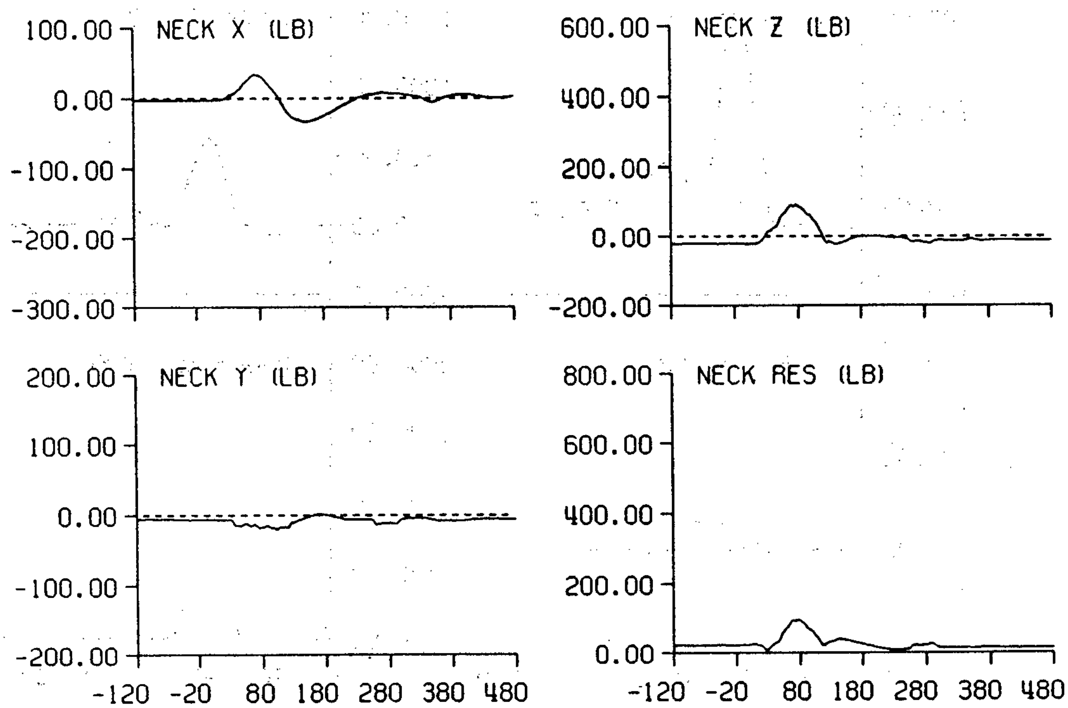
TIME IN MILLISECONDS

JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



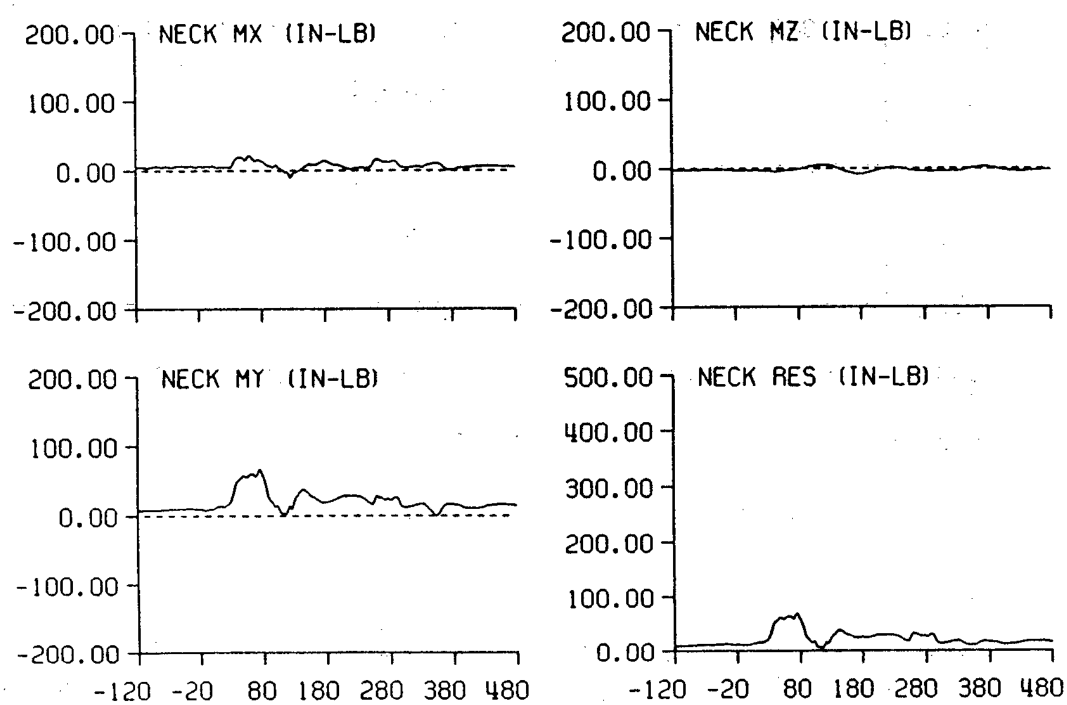
TIME IN MILLISECONDS

JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



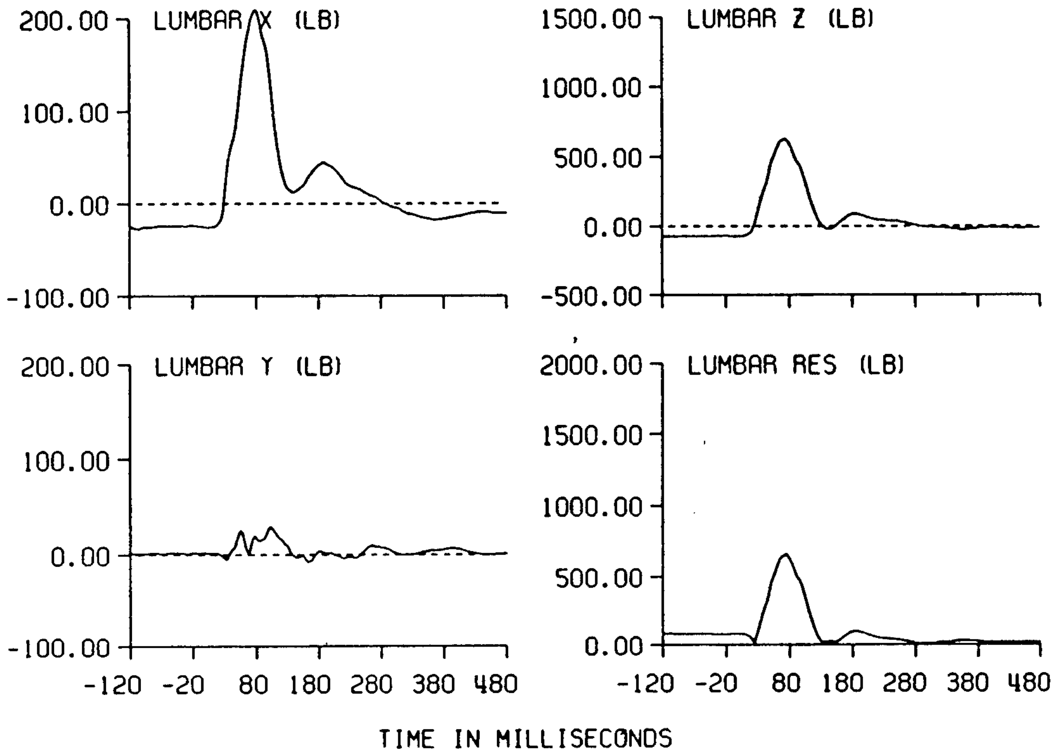
TIME IN MILLISECONDS

JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B

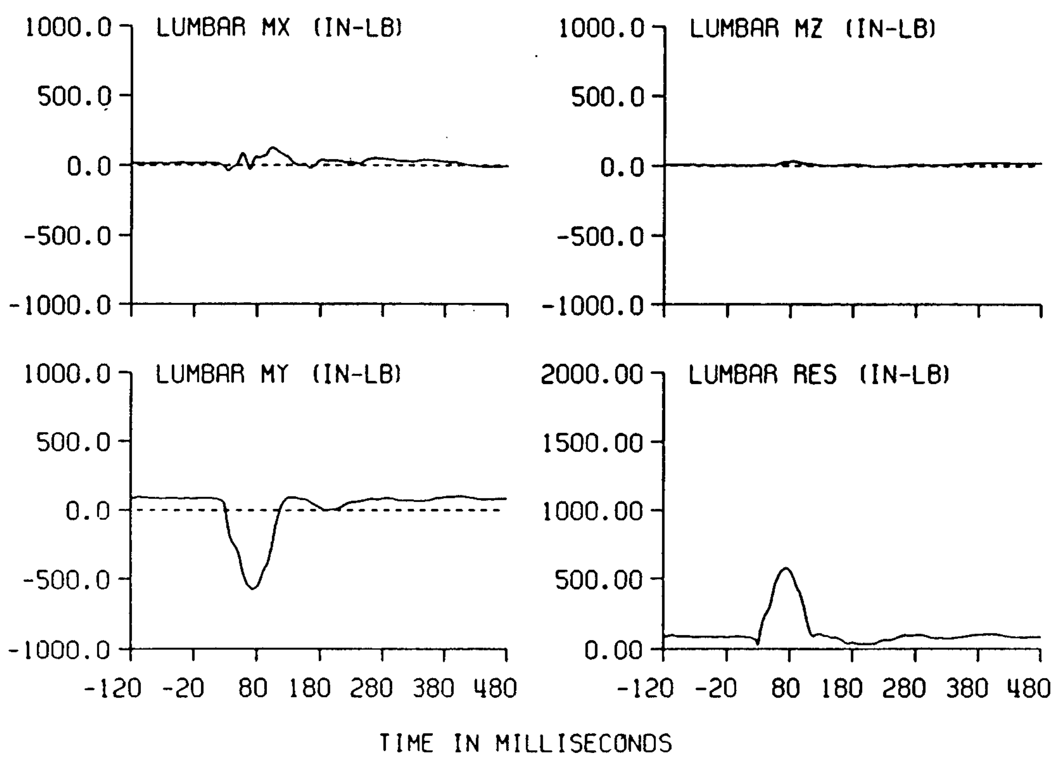


TIME IN MILLISECONDS

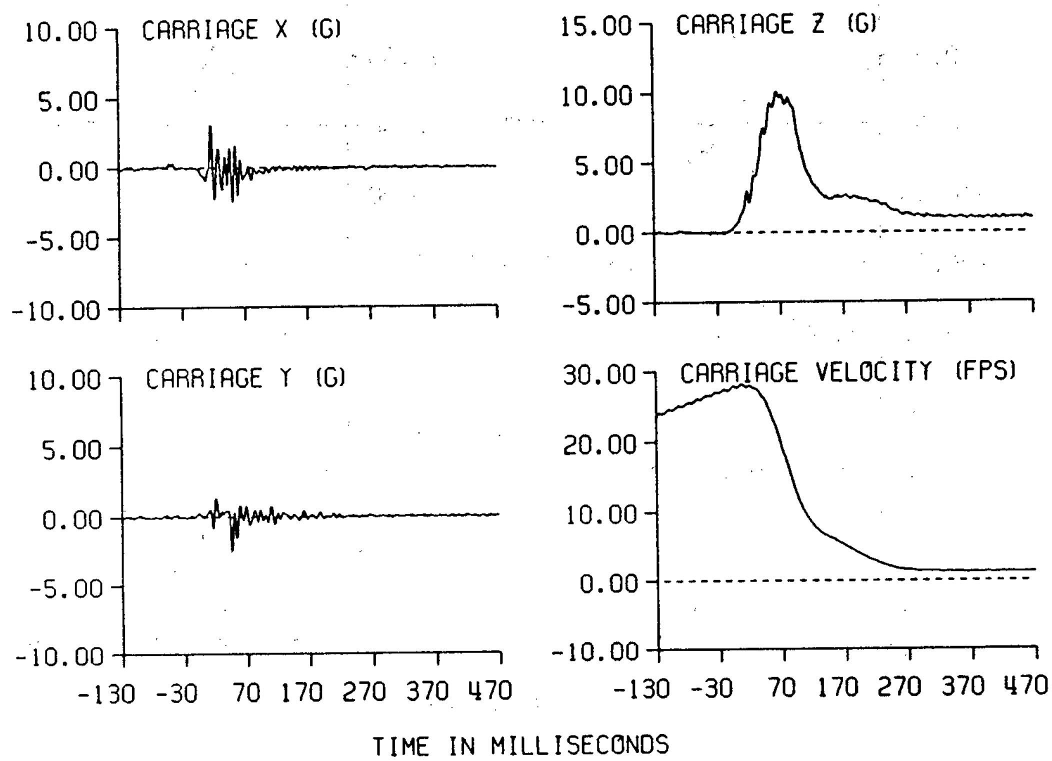
JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B



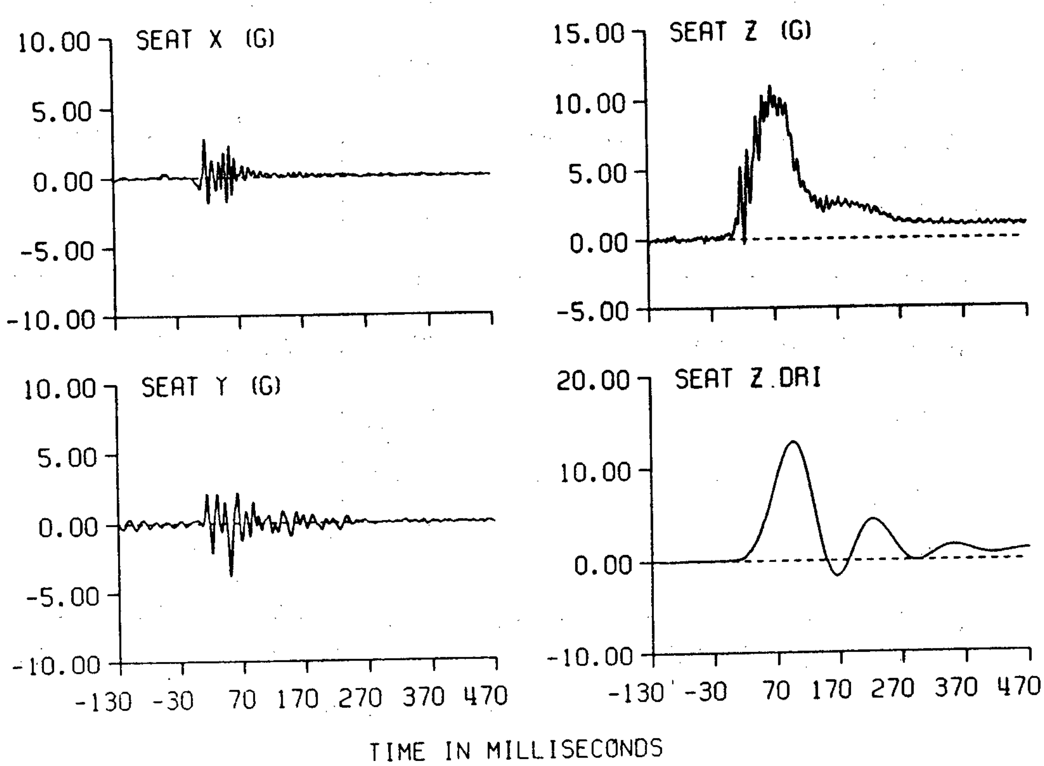
JPATS STUDY TEST: 3336 SUBJ: JPAT-S CELL: B

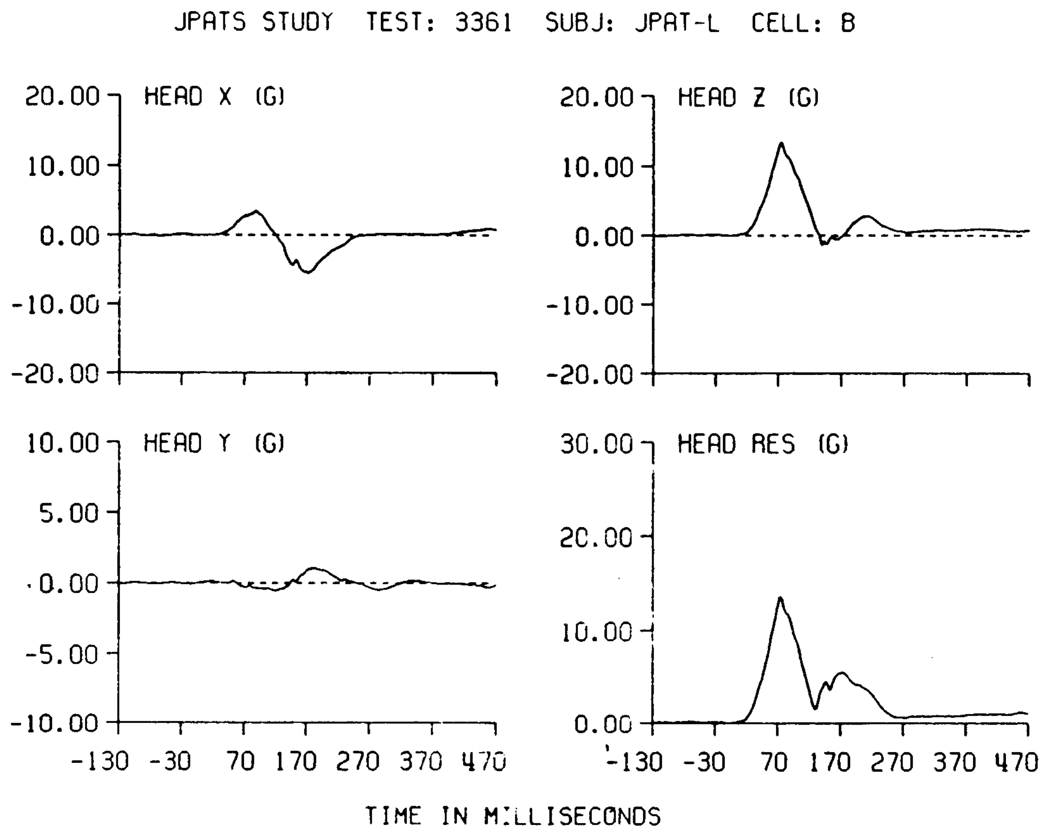


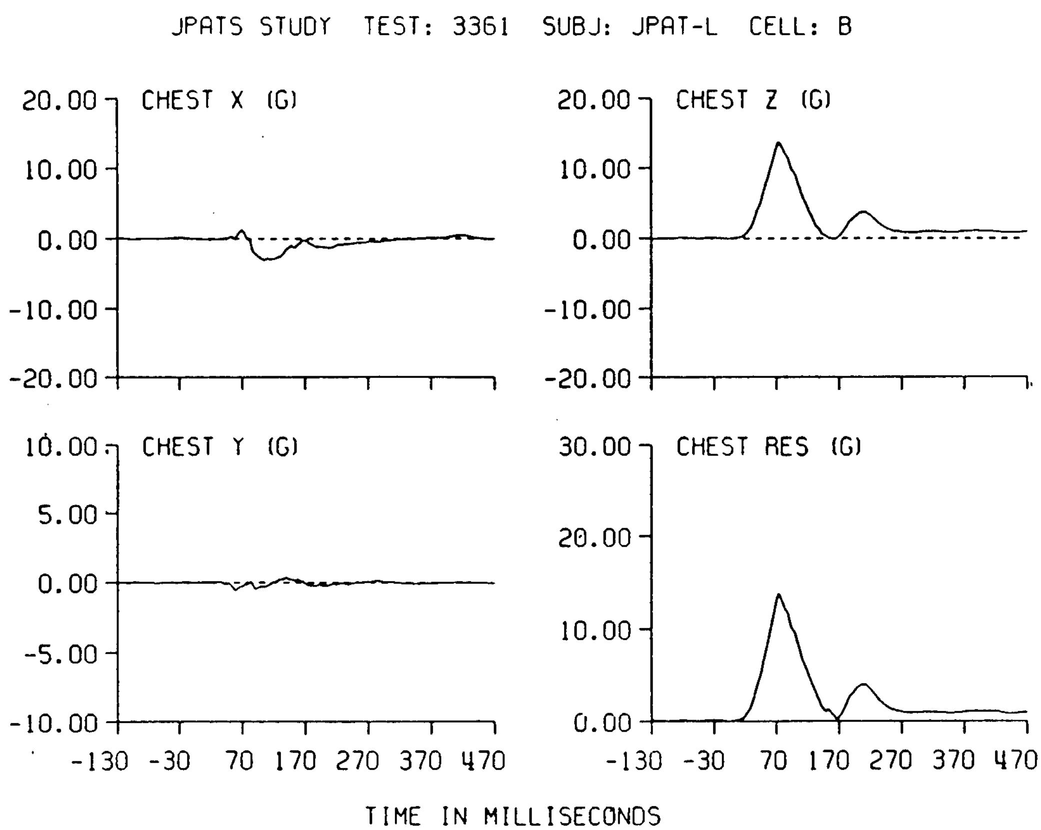
JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B



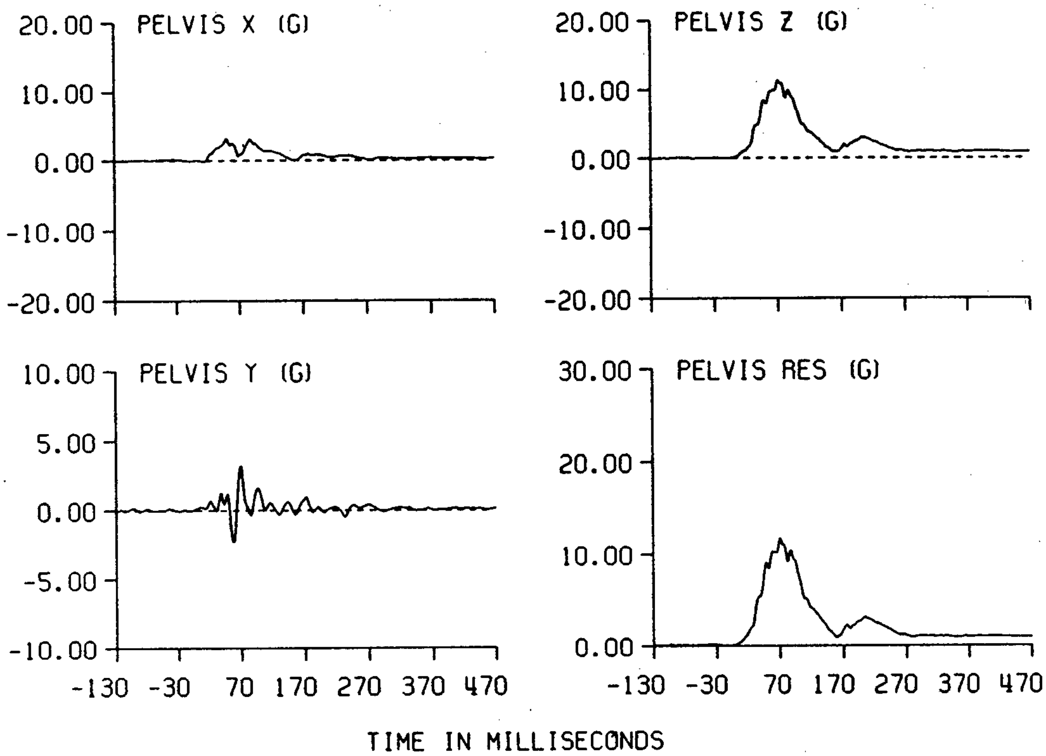
JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B



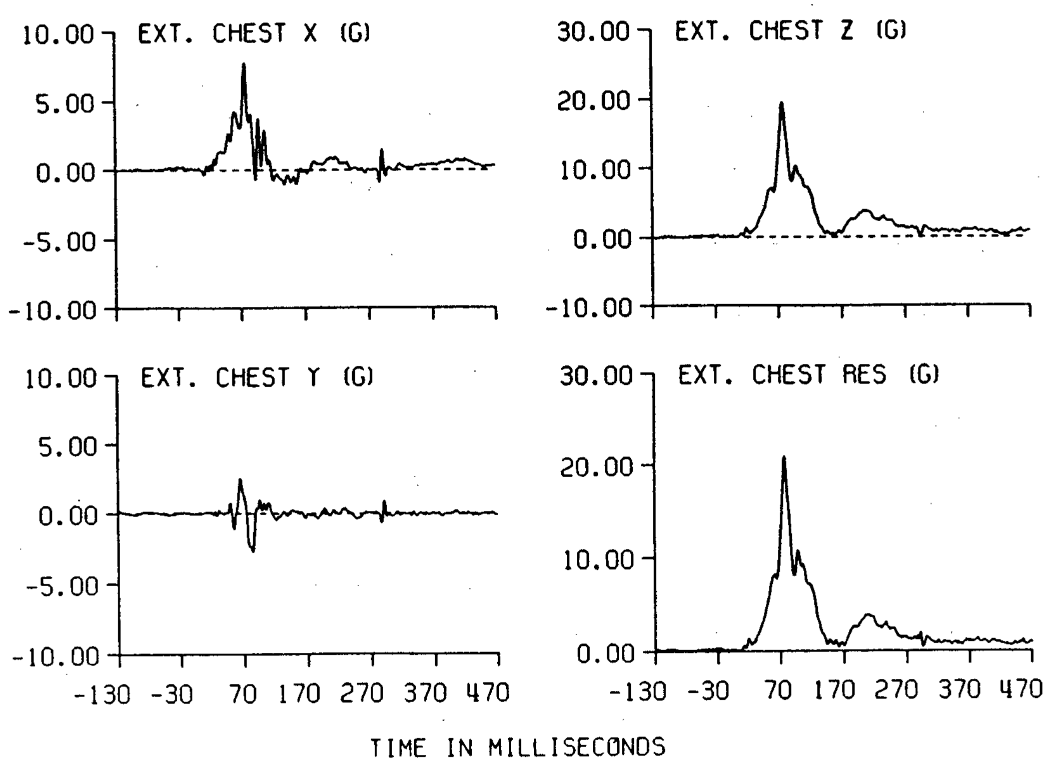

JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
HEAD X (G)
HEAD Z (G)
HEAD Y (G)
HEAD RES (G)
20.00
10.00
0.00
-10.00
-20.00
5.00
-5.00
-10.00
30.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

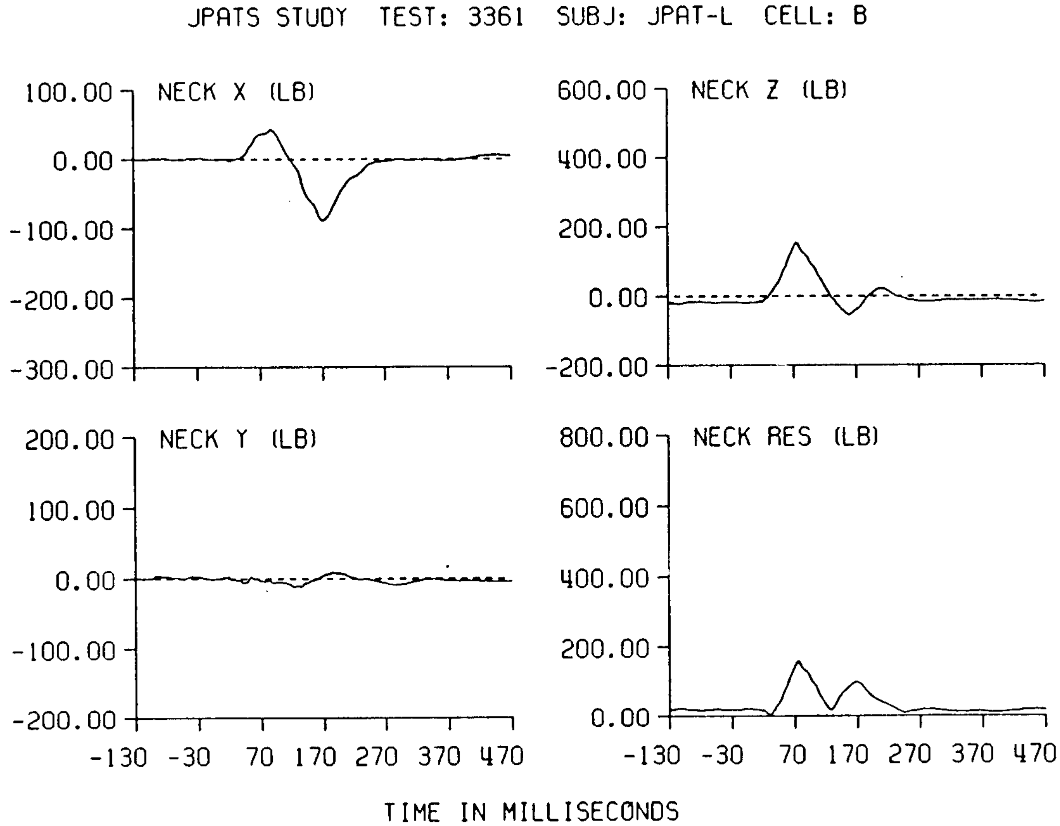

JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
CHEST X (G)
CHEST Z (G)
CHEST Y (G)
CHEST RES (G)
20.00
10.00
0.00
-10.00
-20.00
5.00
-5.00
-10.00
30.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

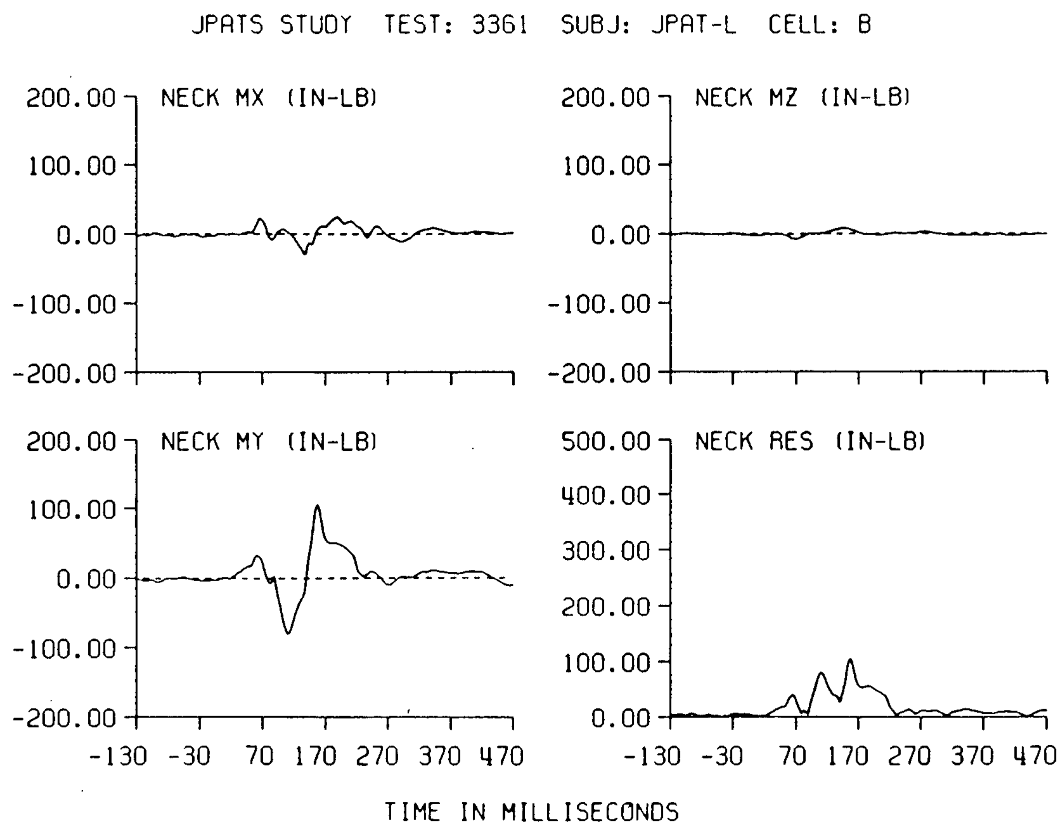
JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B

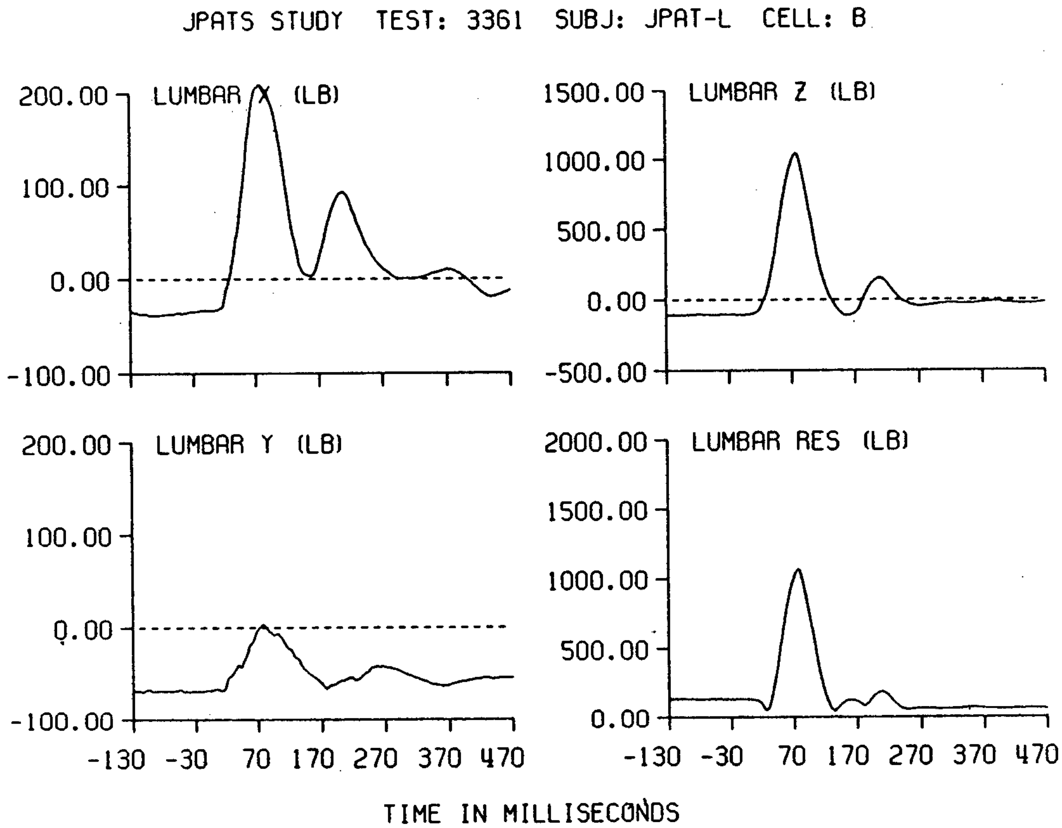


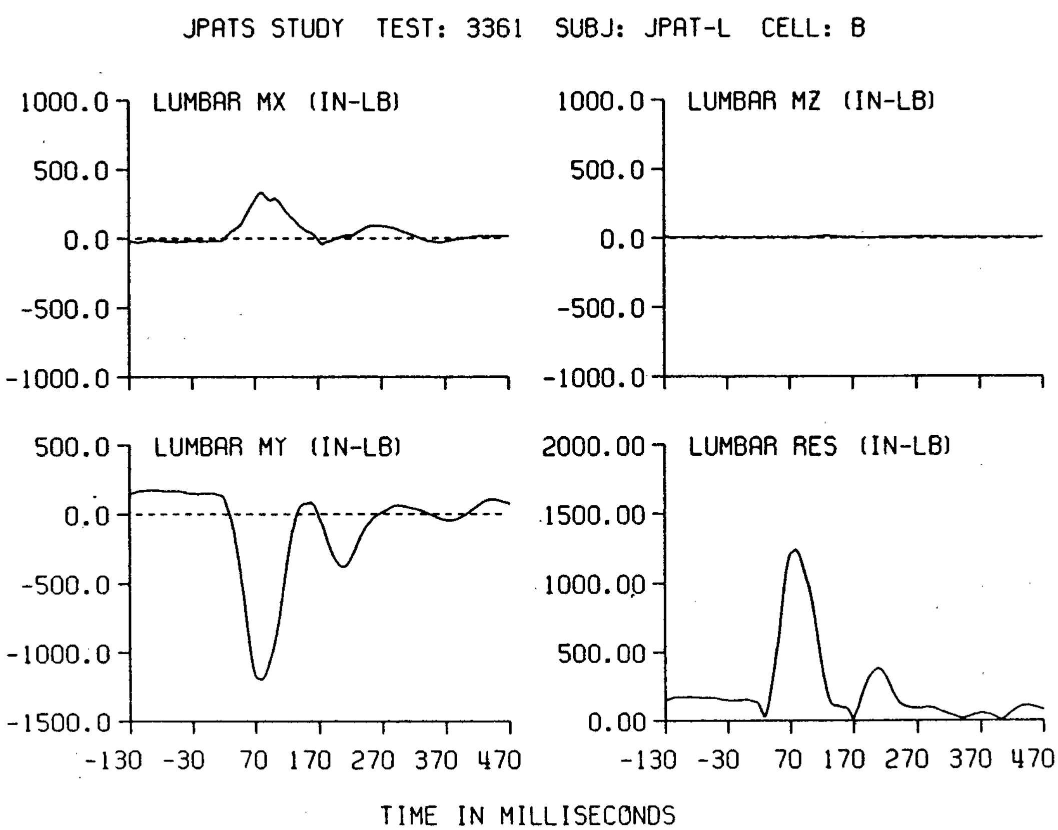
JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B



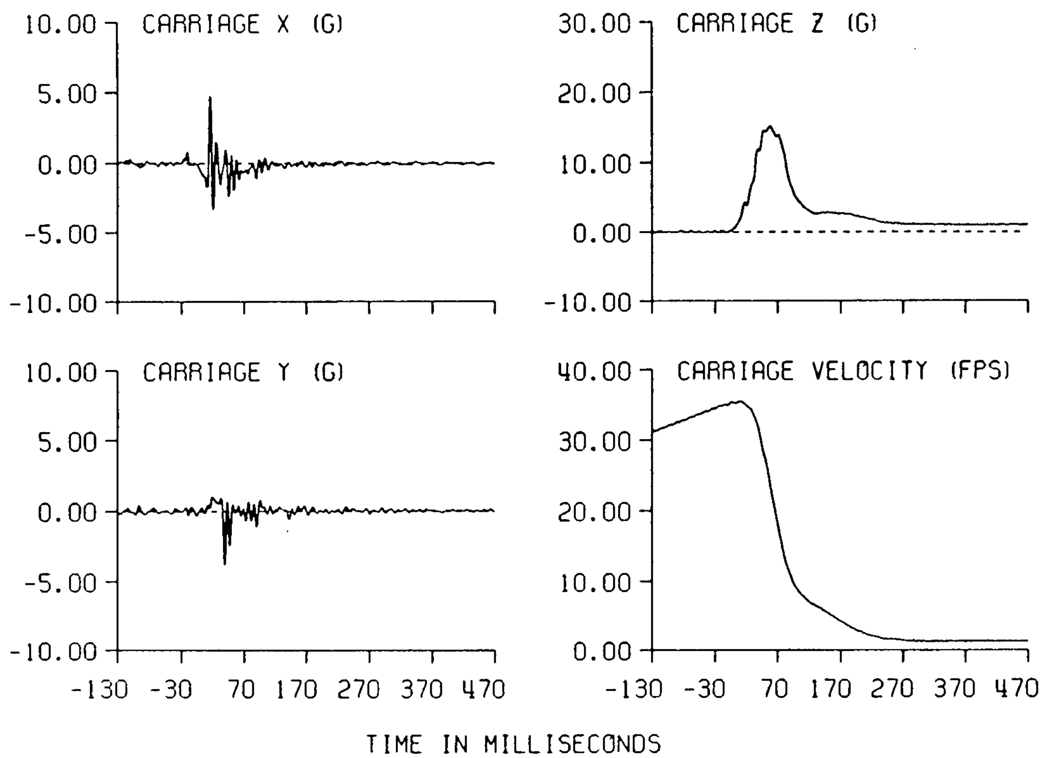

JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS


JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
500.00
400.00
300.00
200.00
100.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

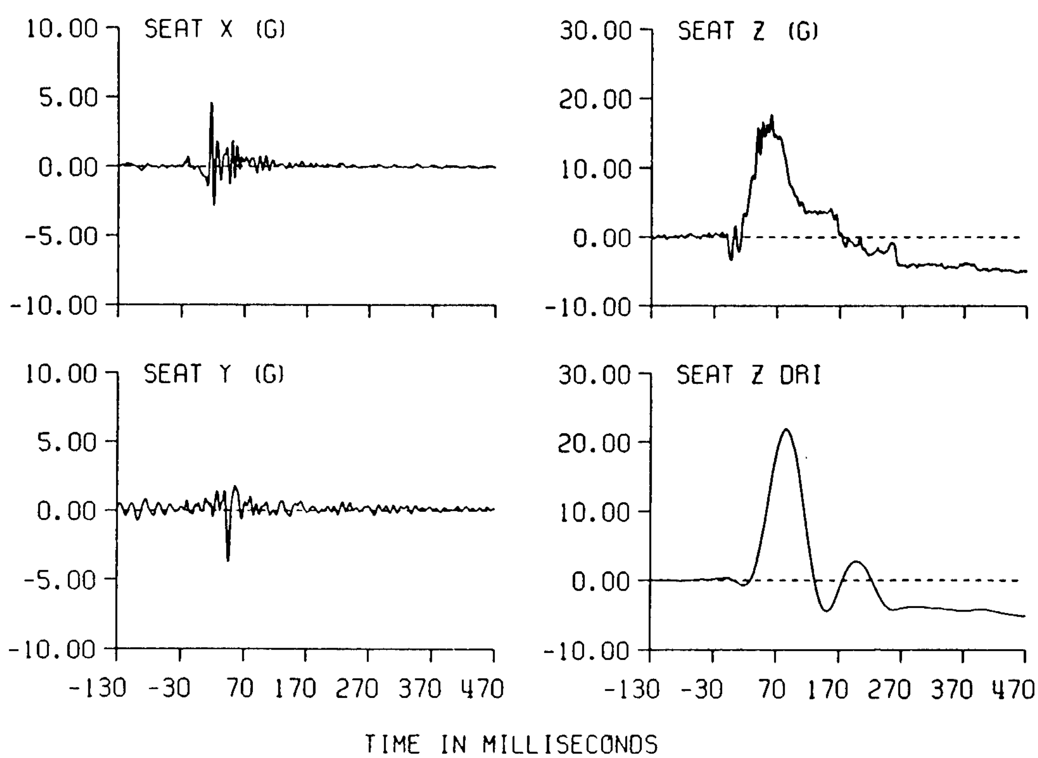

JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
LUMBAR X (LB)
LUMBAR Z (LB)
LUMBAR Y (LB)
LUMBAR RES (LB)
200.00
100.00
0.00
-100.00
1500.00
1000.00
500.00
-500.00
2000.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS


JPATS STUDY TEST: 3361 SUBJ: JPAT-L CELL: B
LUMBAR MX (IN-LB)
LUMBAR MZ (IN-LB)
LUMBAR MY (IN-LB)
LUMBAR RES (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
-1500.0
2000.00
1500.00
1000.00
500.00
0.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

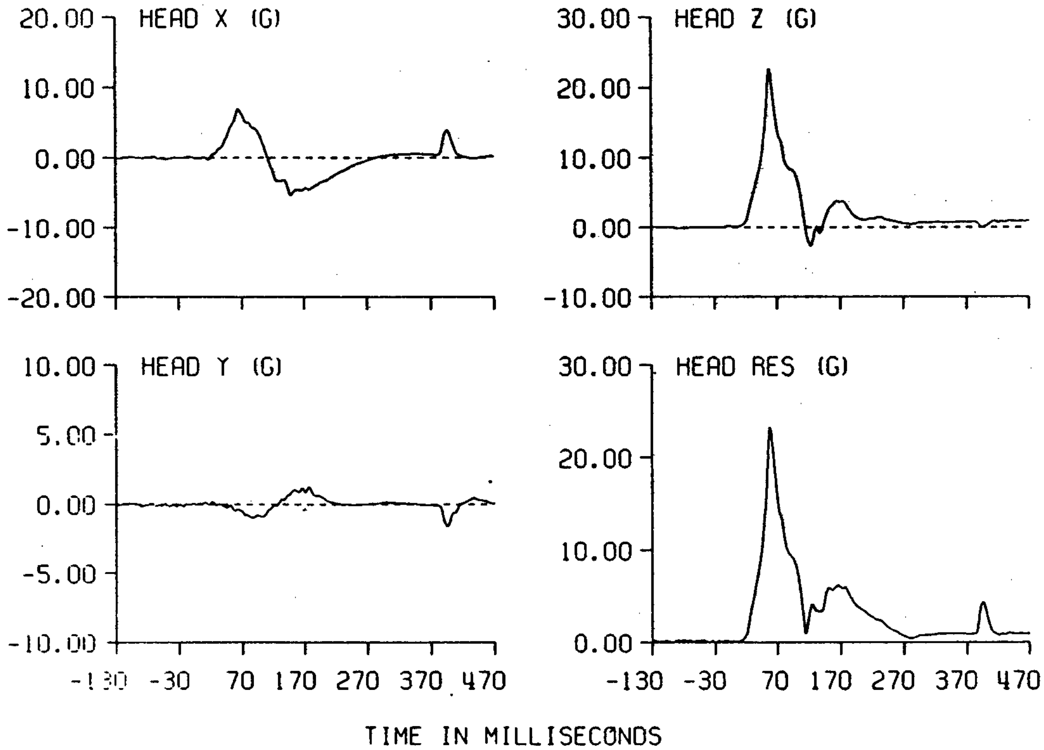
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



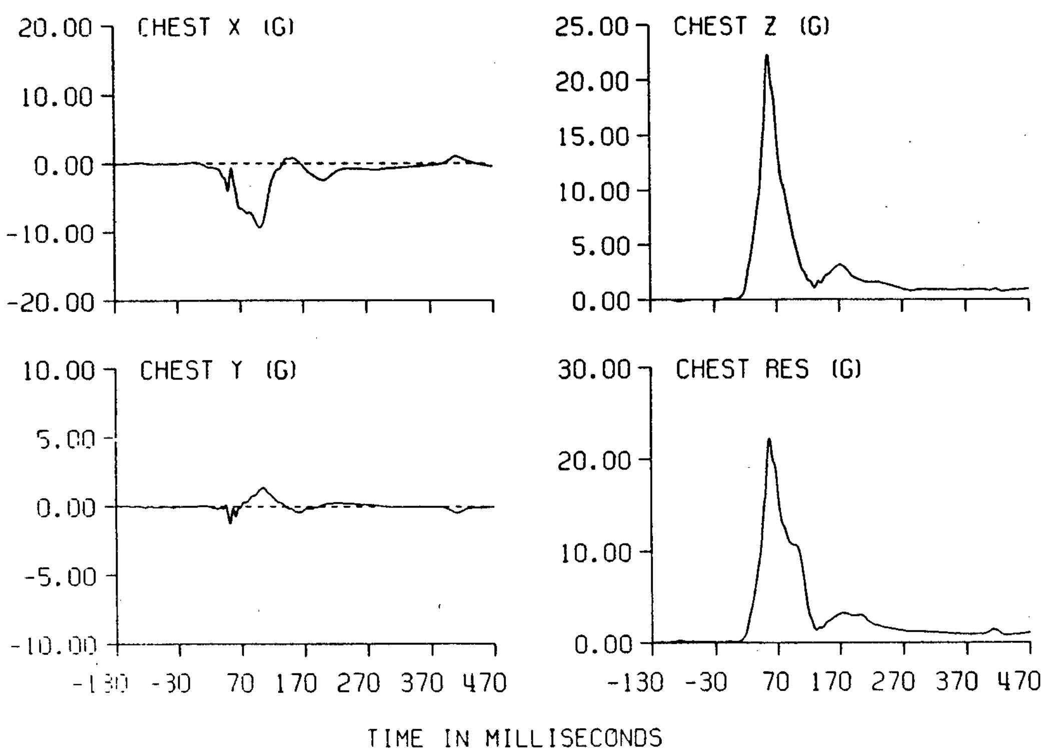
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



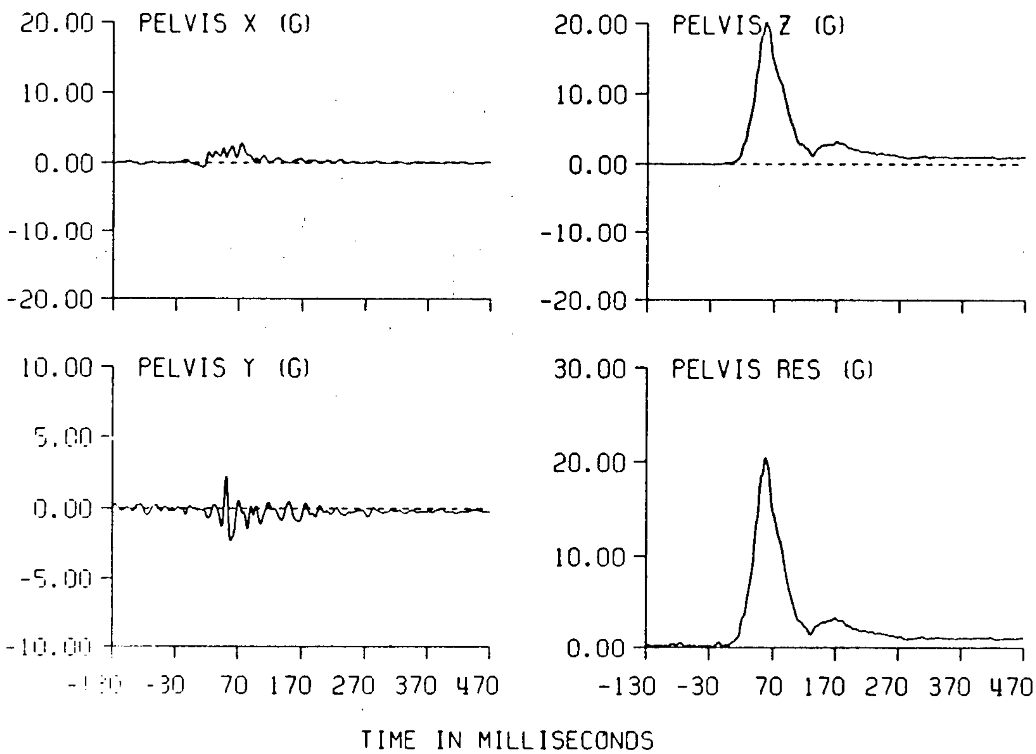
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



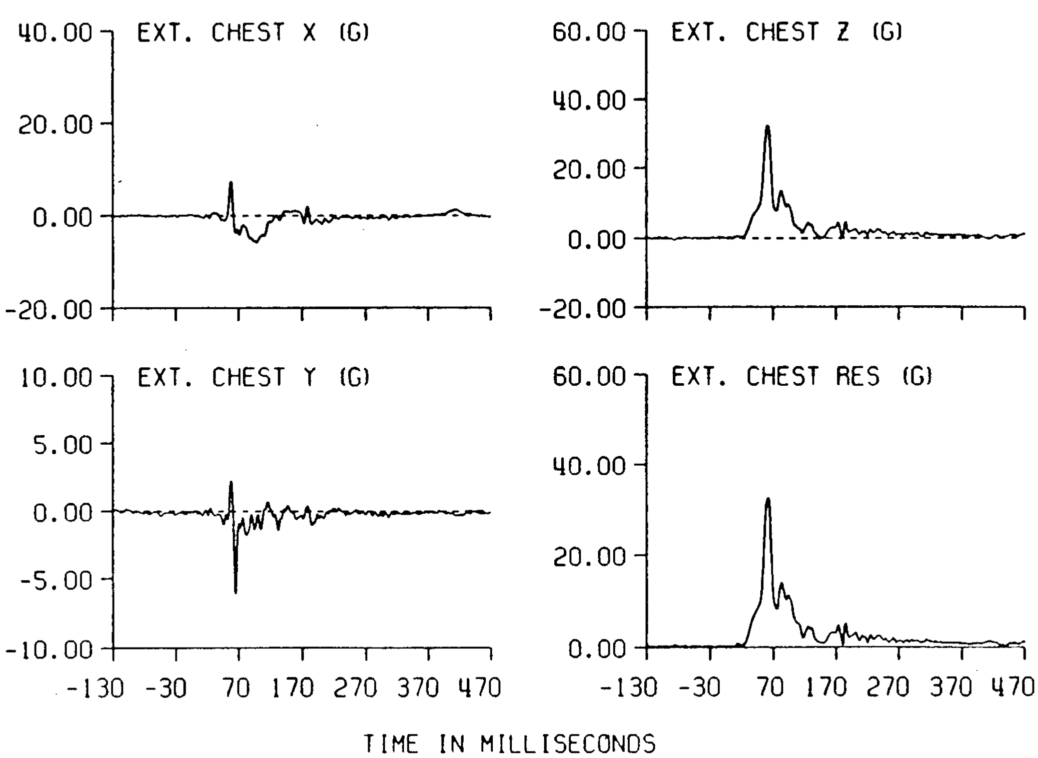
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



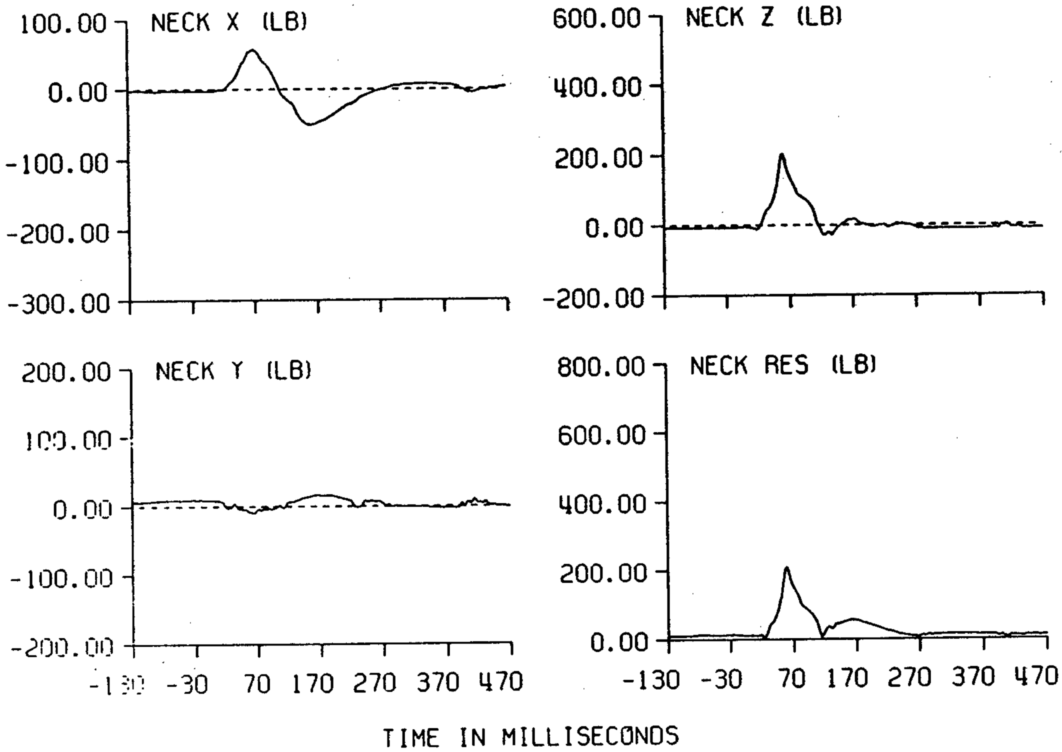
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



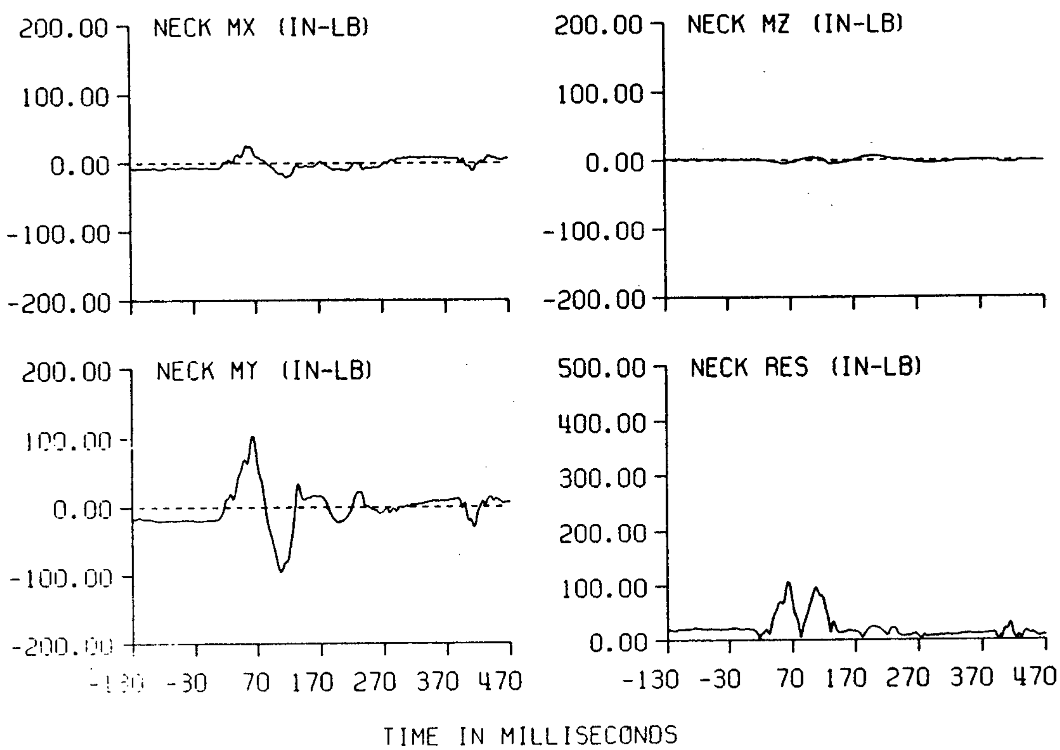
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C

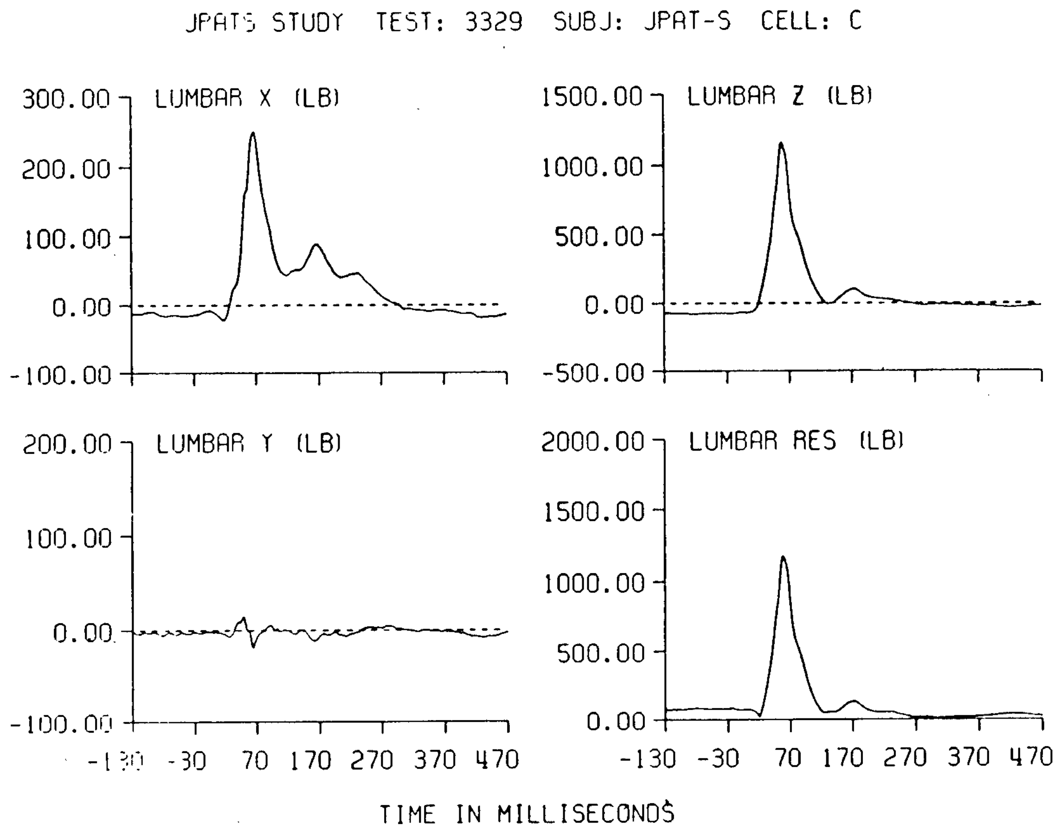


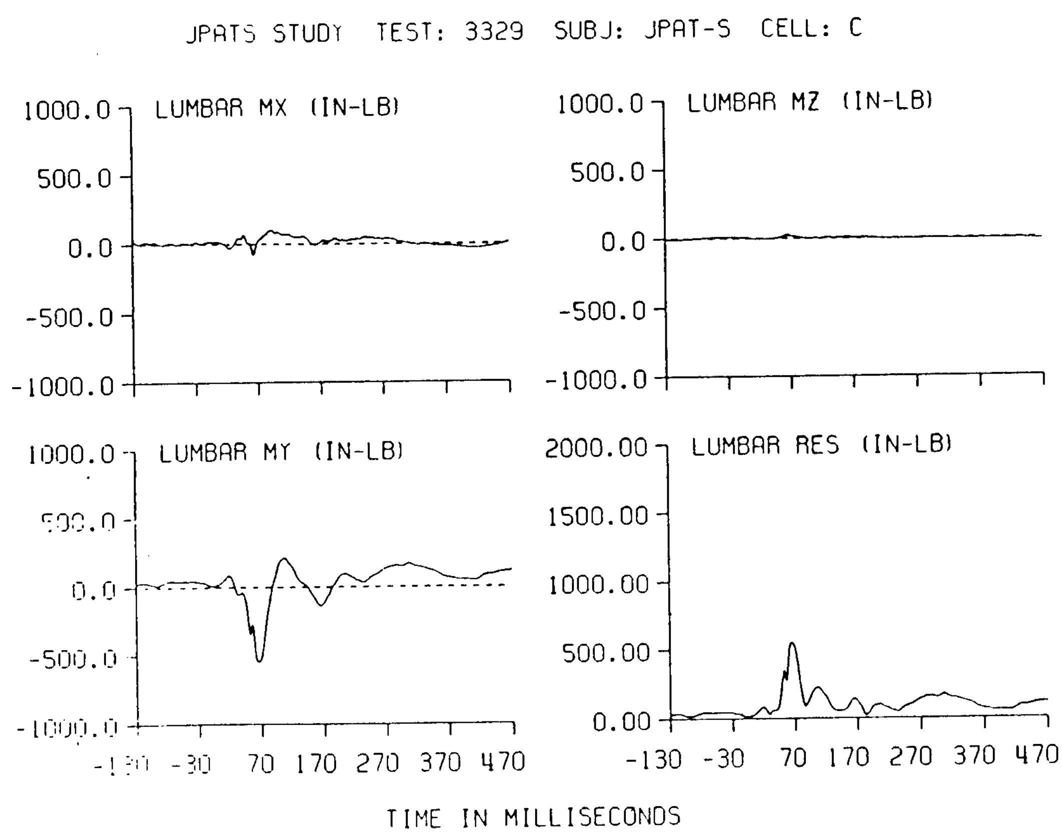
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



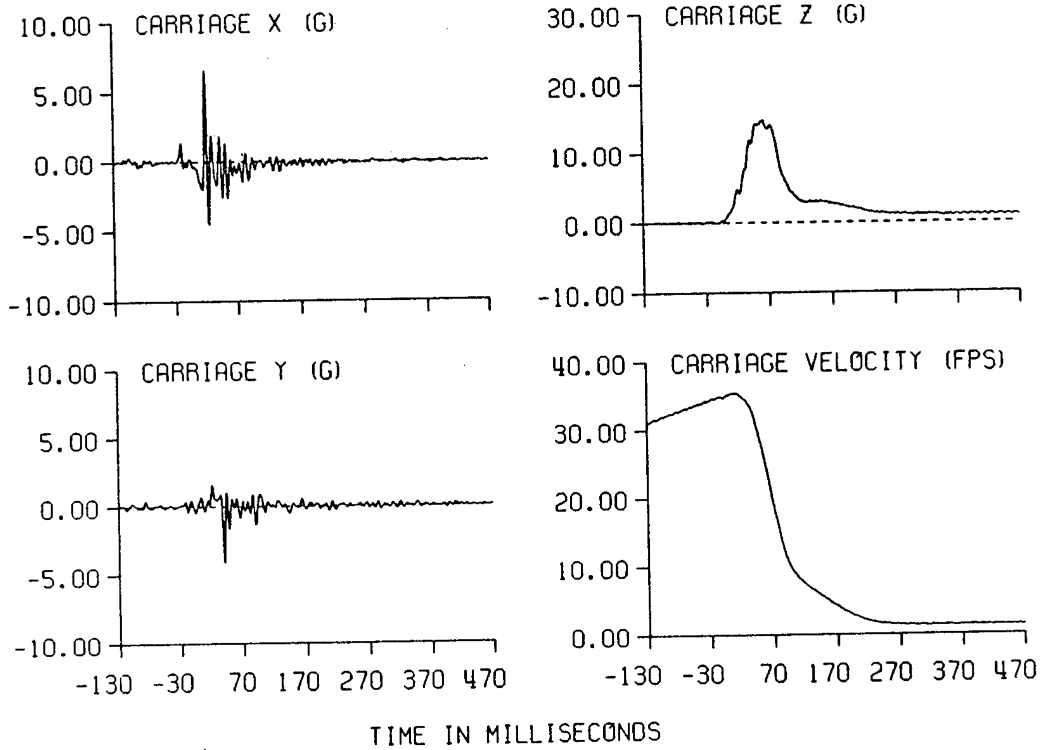
JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C



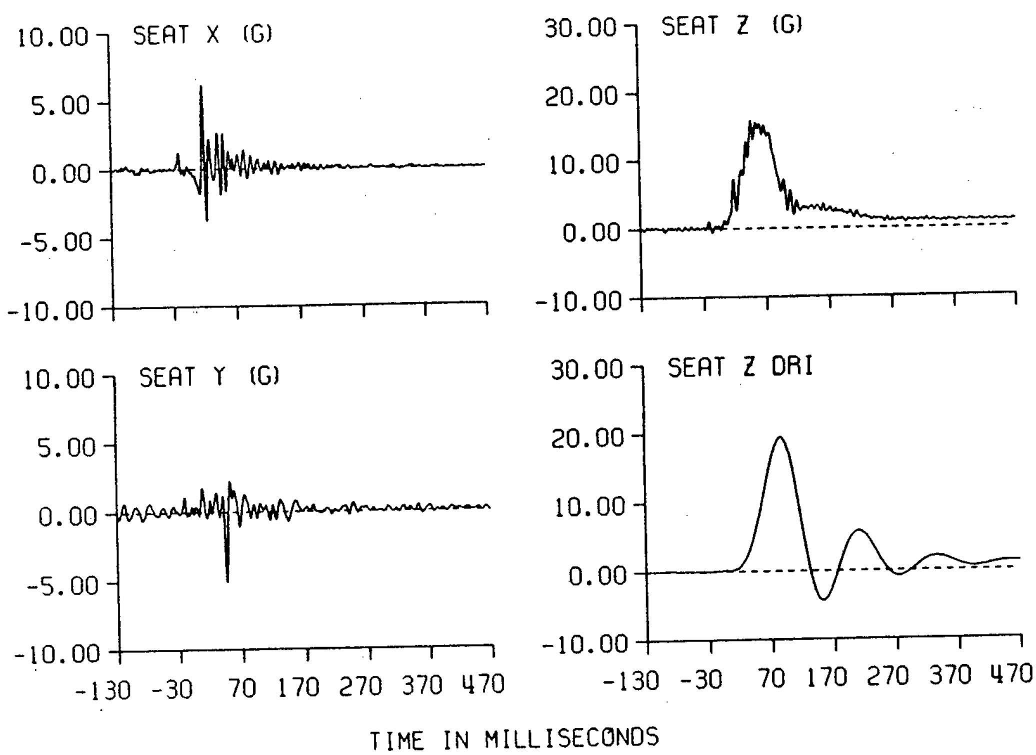

JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C
LUMBAR X (LB)
LUMBAR Z (LB)
LUMBAR Y (LB)
LUMBAR RES (LB)
300.00
200.00
100.00
0.00
-100.00
1500.00
1000.00
500.00
0.00
-500.00
200.00
100.00
0.00
-100.00
2000.00
1500.00
1000.00
500.00
0.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS


JPATS STUDY TEST: 3329 SUBJ: JPAT-S CELL: C
LUMBAR MX (IN-LB)
LUMBAR MZ (IN-LB)
LUMBAR MY (IN-LB)
LUMBAR RES (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
2000.00
1500.00
1000.00
500.00
0.00
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

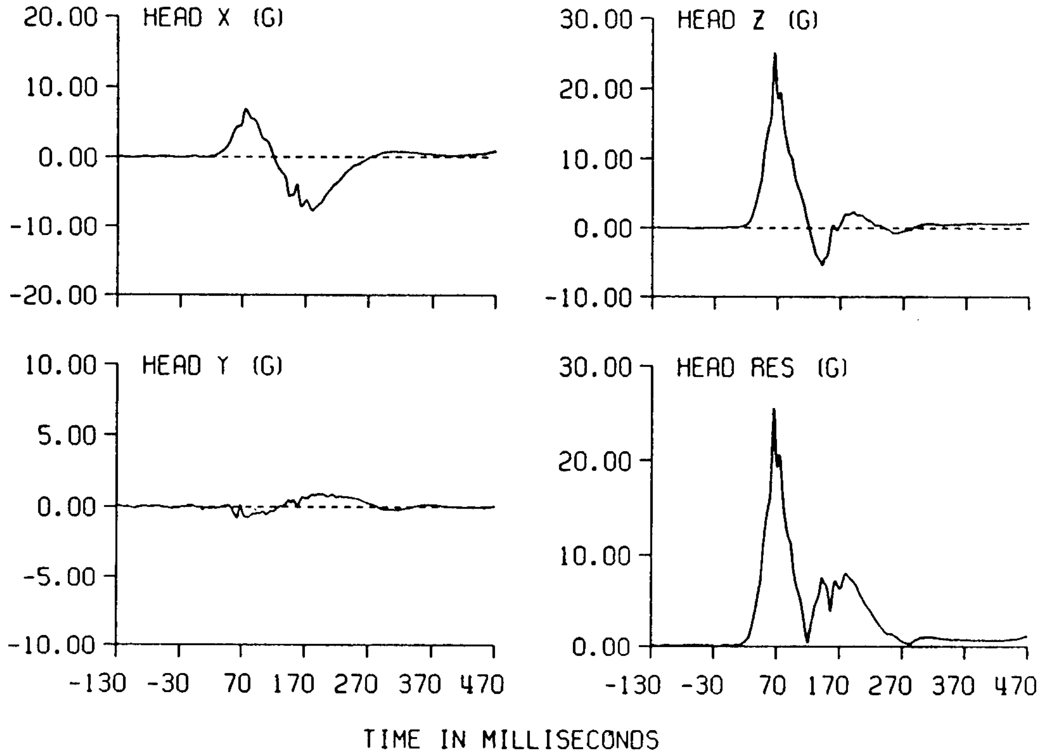
JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



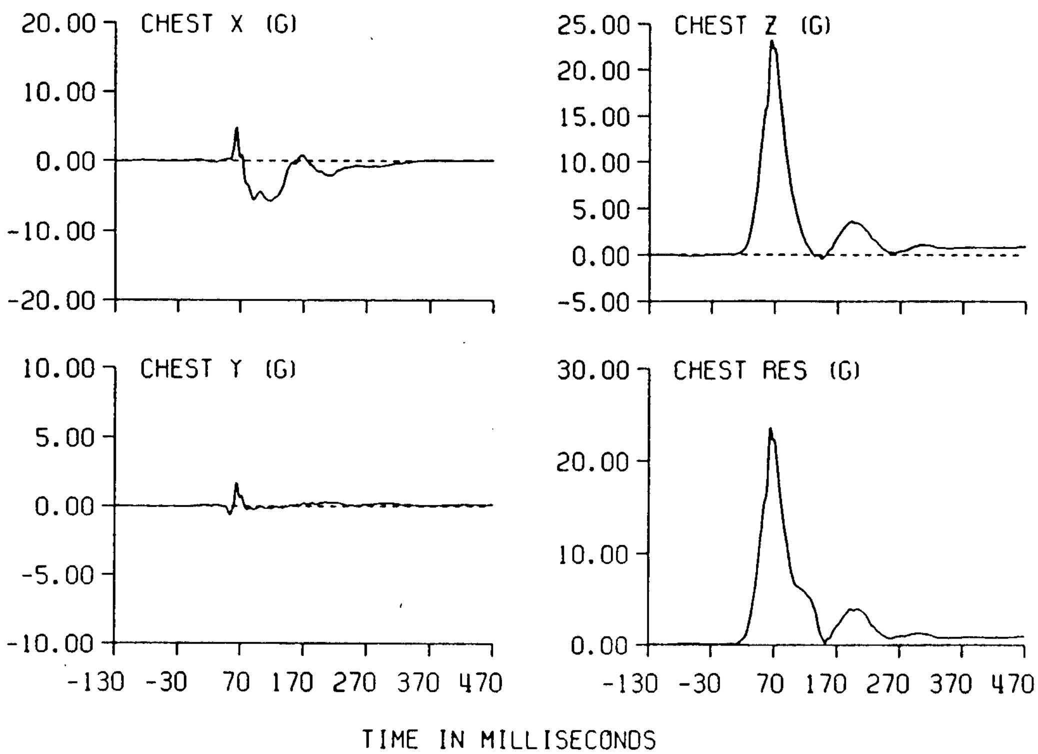
JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



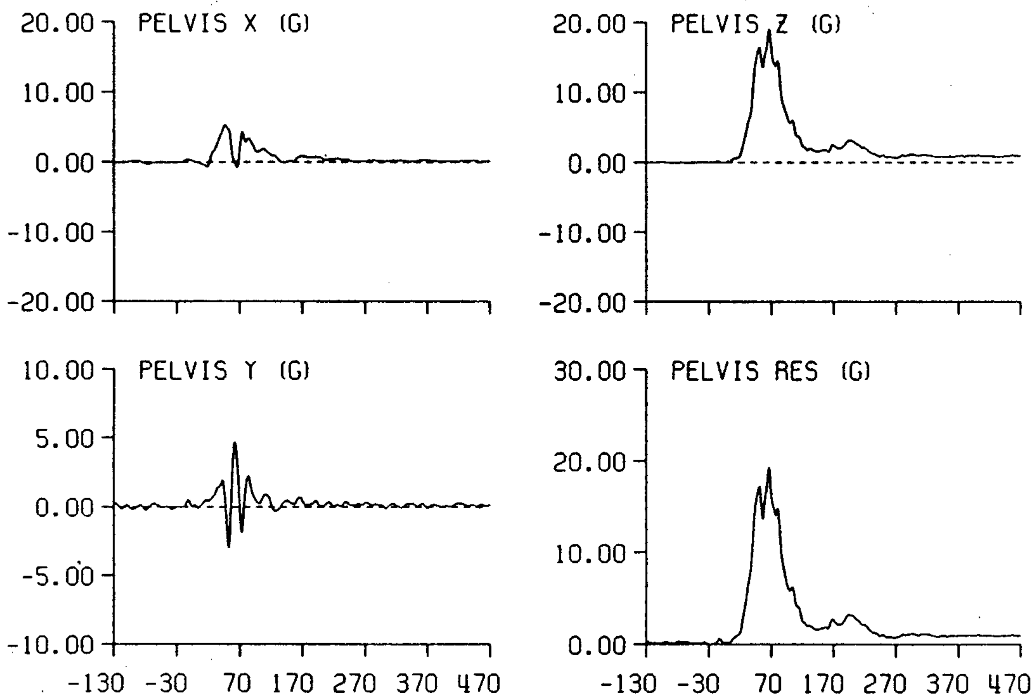
JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C

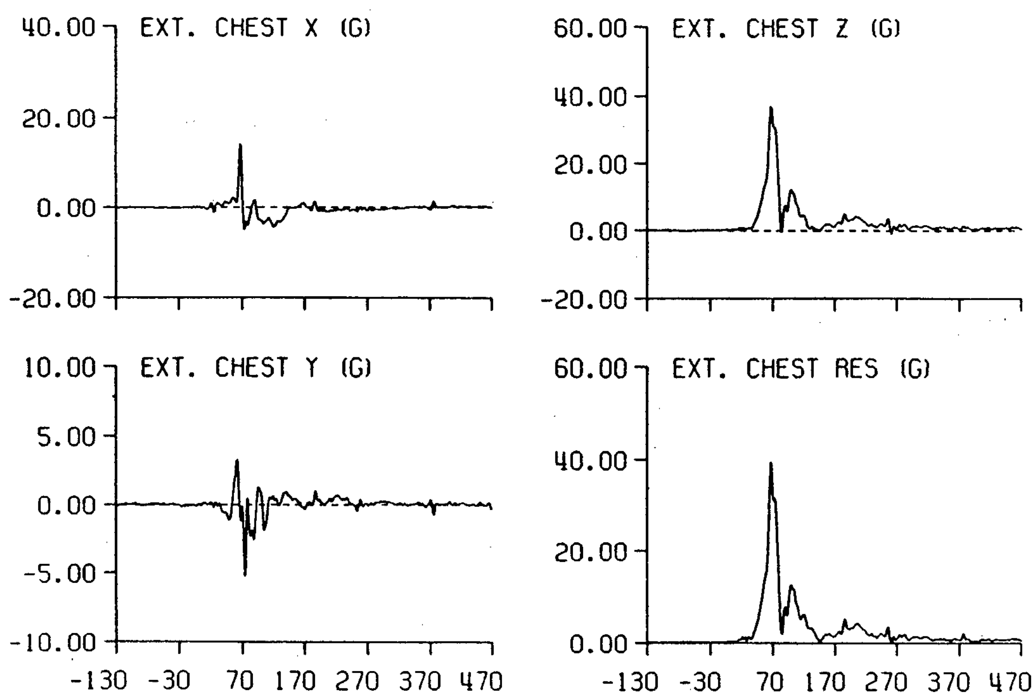


JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



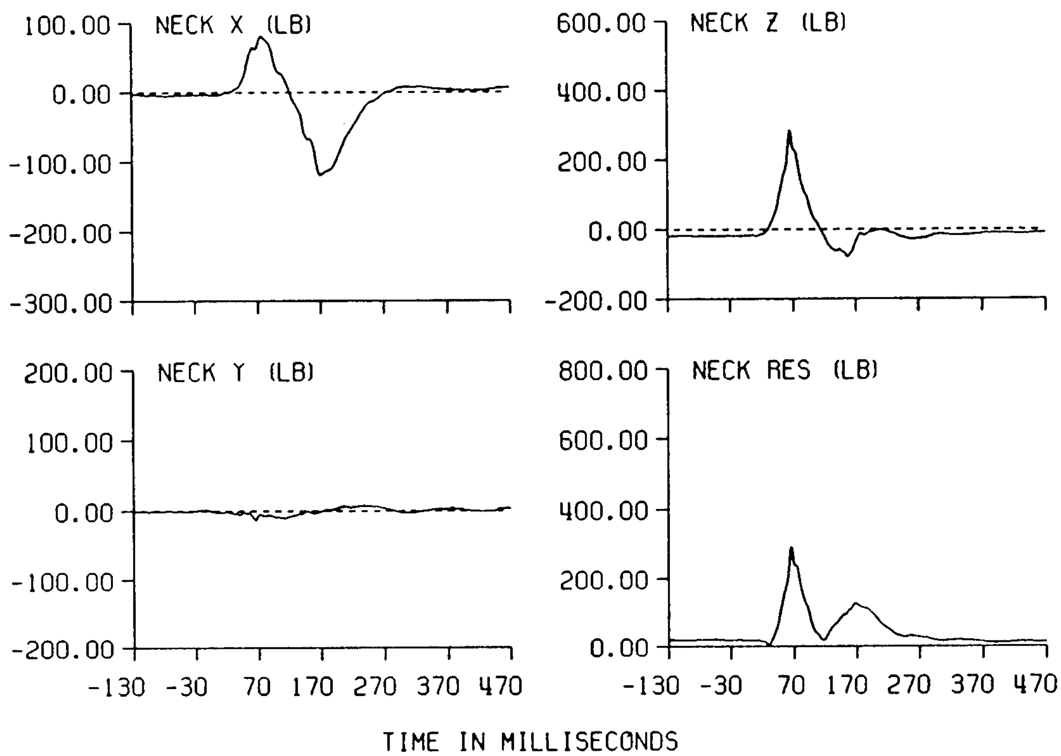
TIME IN MILLISECONDS

JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C

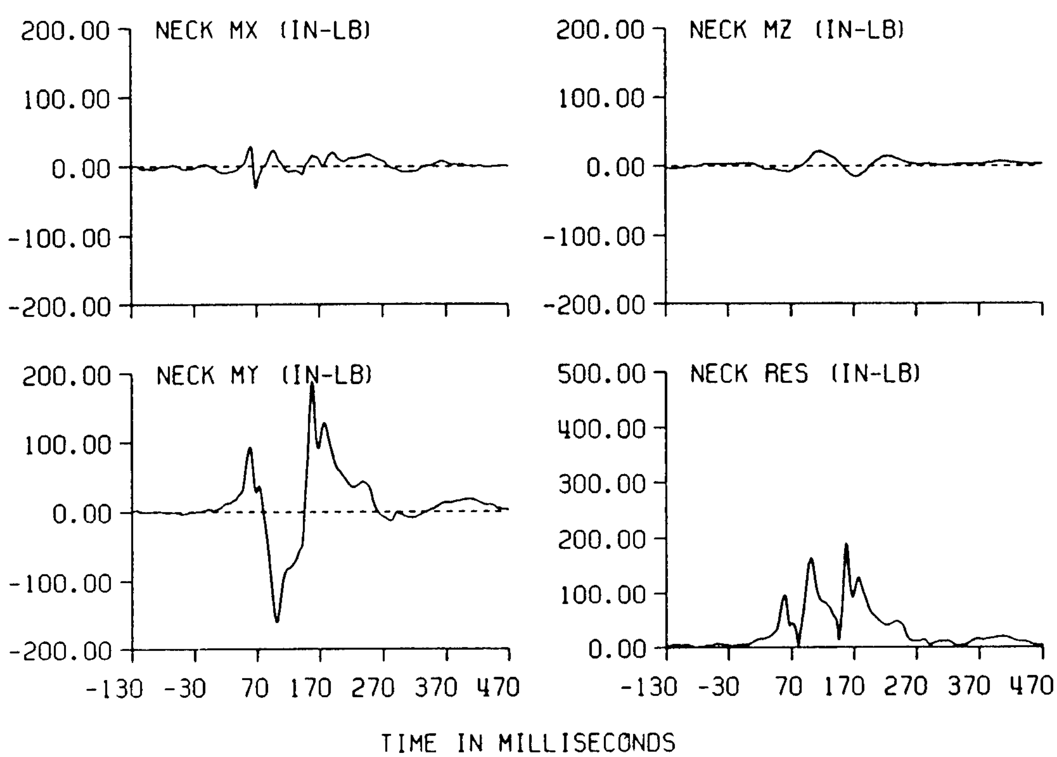


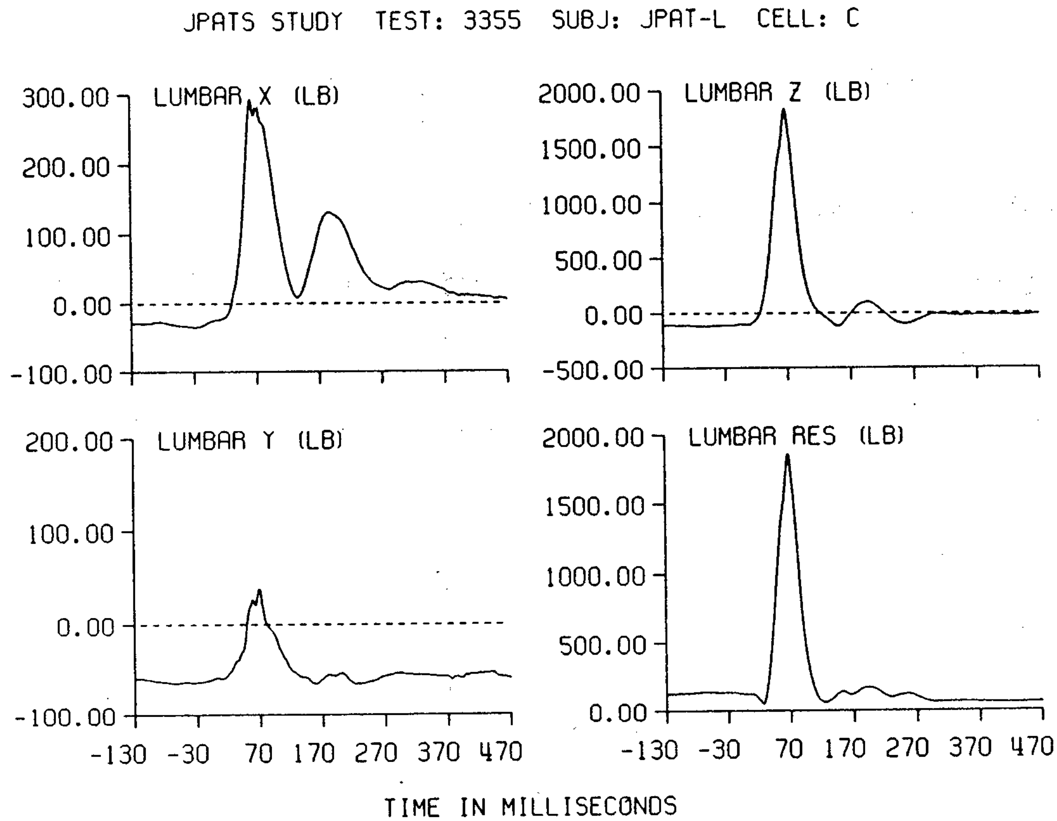
TIME IN MILLISECONDS

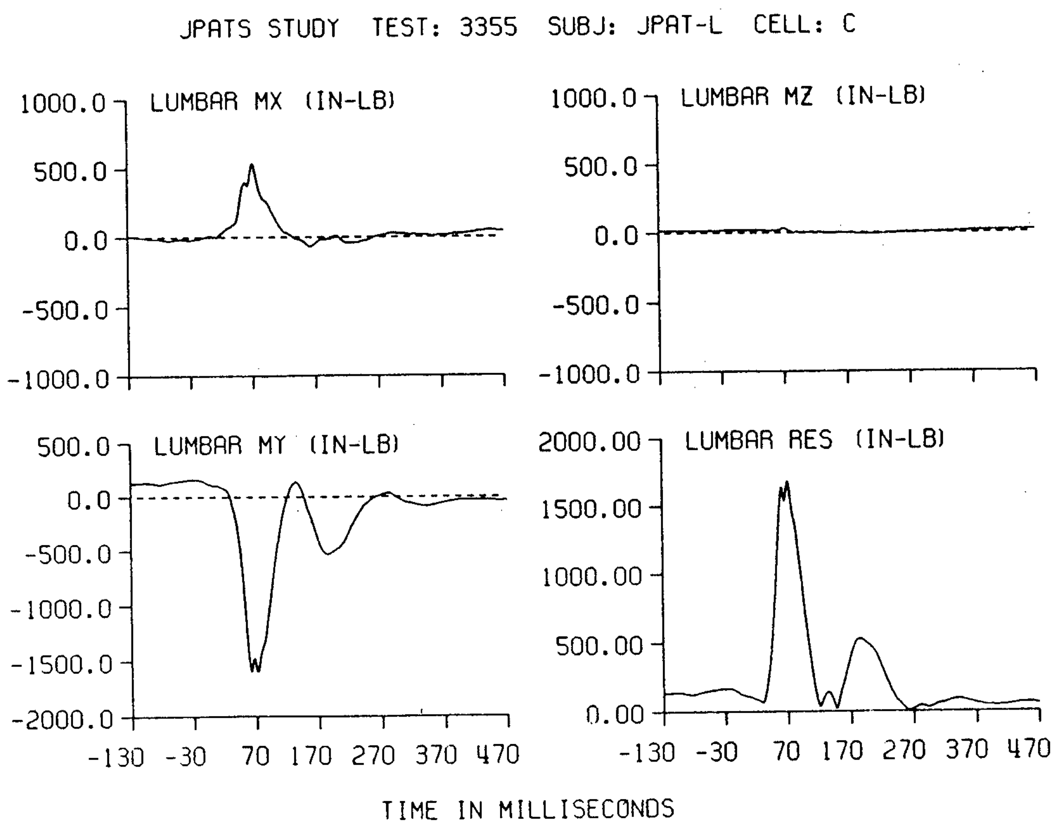
JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



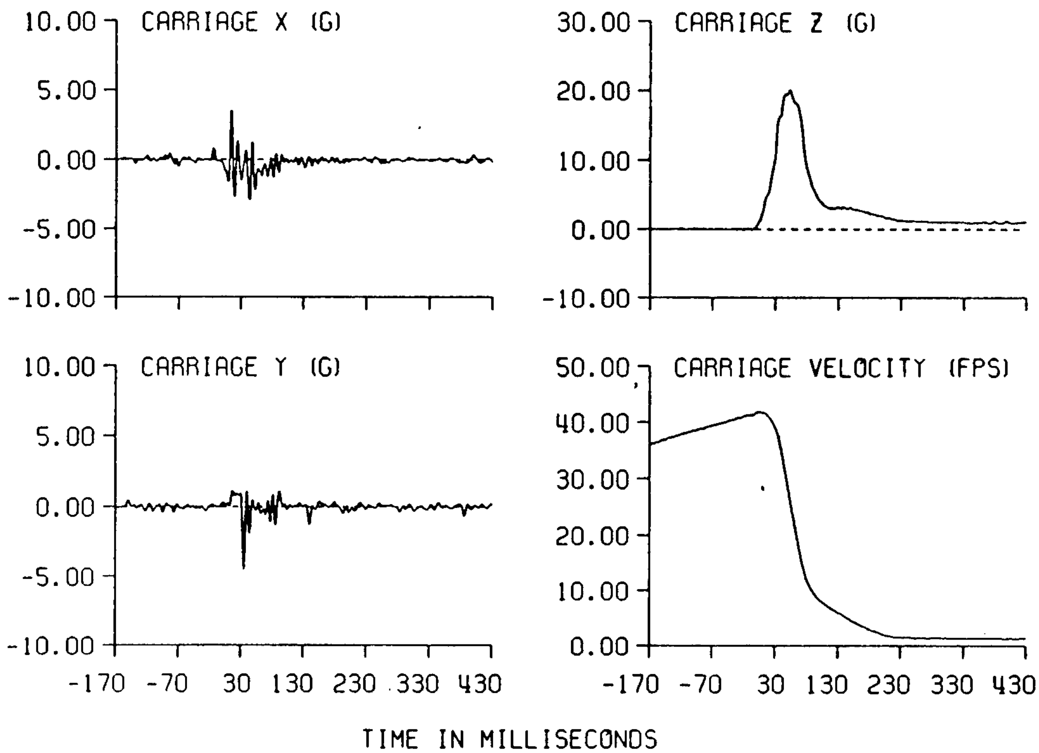
JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C



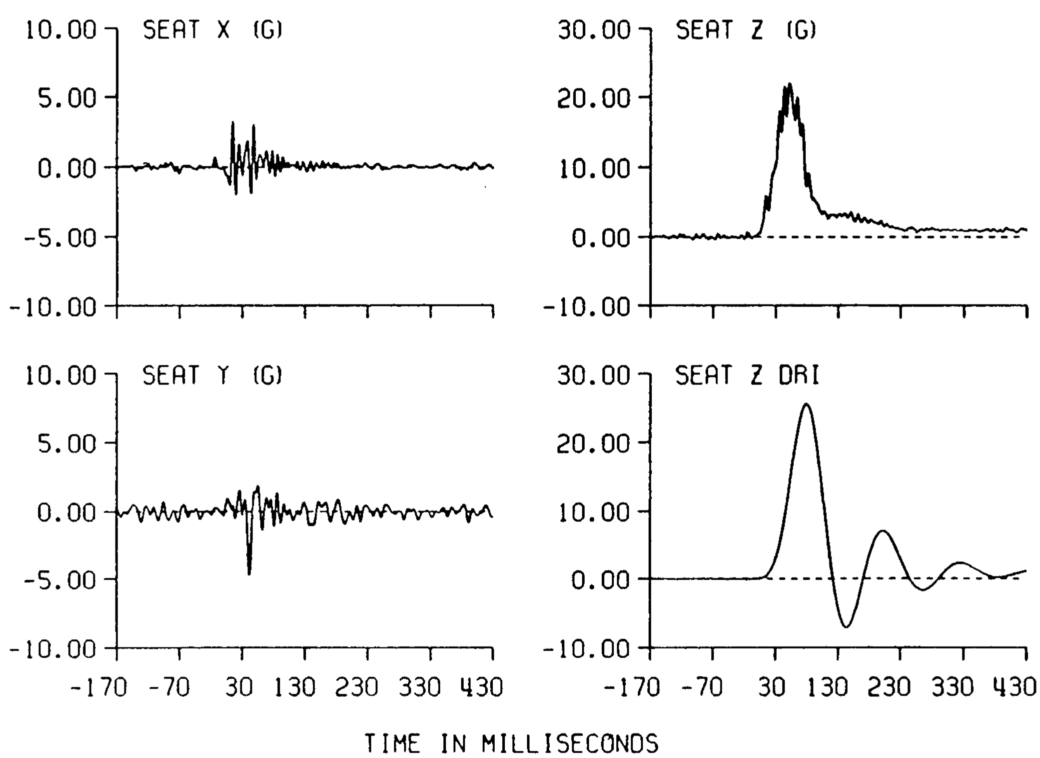

JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C
LUMBAR X (LB)
300.00
200.00
100.00
0.00
-100.00
LUMBAR Z (LB)
2000.00
1500.00
1000.00
500.00
0.00
-500.00
LUMBAR Y (LB)
200.00
100.00
0.00
-100.00
LUMBAR RES (LB)
2000.00
1500.00
1000.00
500.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS


JPATS STUDY TEST: 3355 SUBJ: JPAT-L CELL: C
LUMBAR MX (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
LUMBAR MZ (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
LUMBAR MY (IN-LB)
500.0
0.0
-500.0
-1000.0
-1500.0
-2000.0
LUMBAR RES (IN-LB)
2000.00
1500.00
1000.00
500.00
0.00
-130 -30 70 170 270 370 470
-130 -30 70 170 270 370 470
TIME IN MILLISECONDS

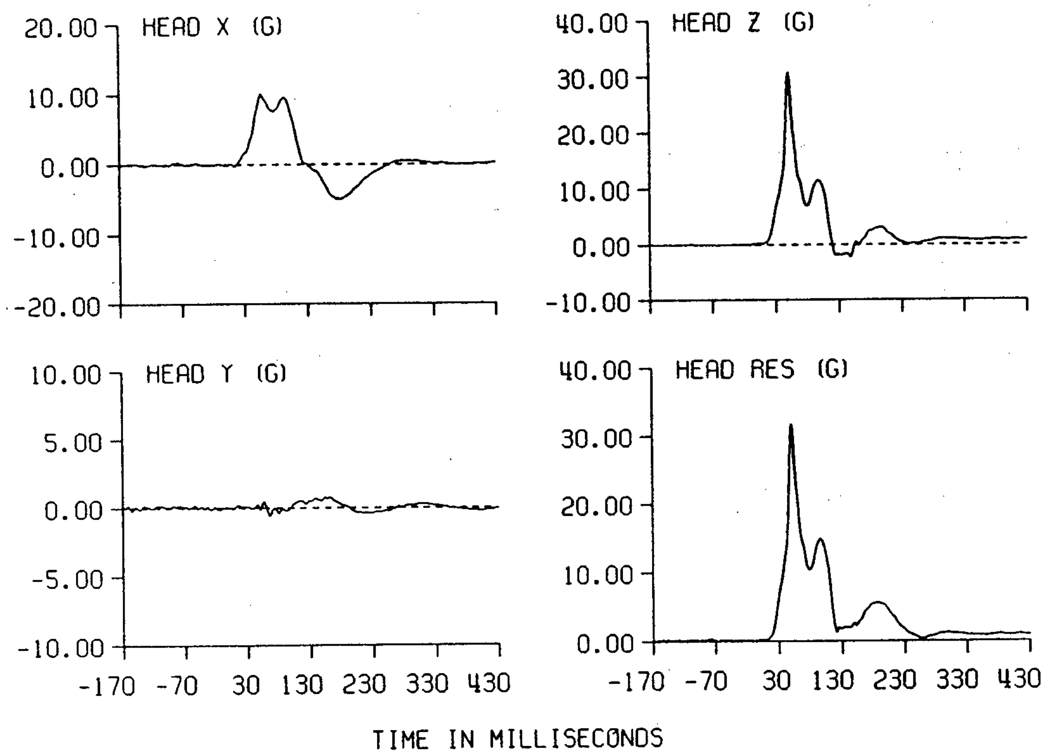
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



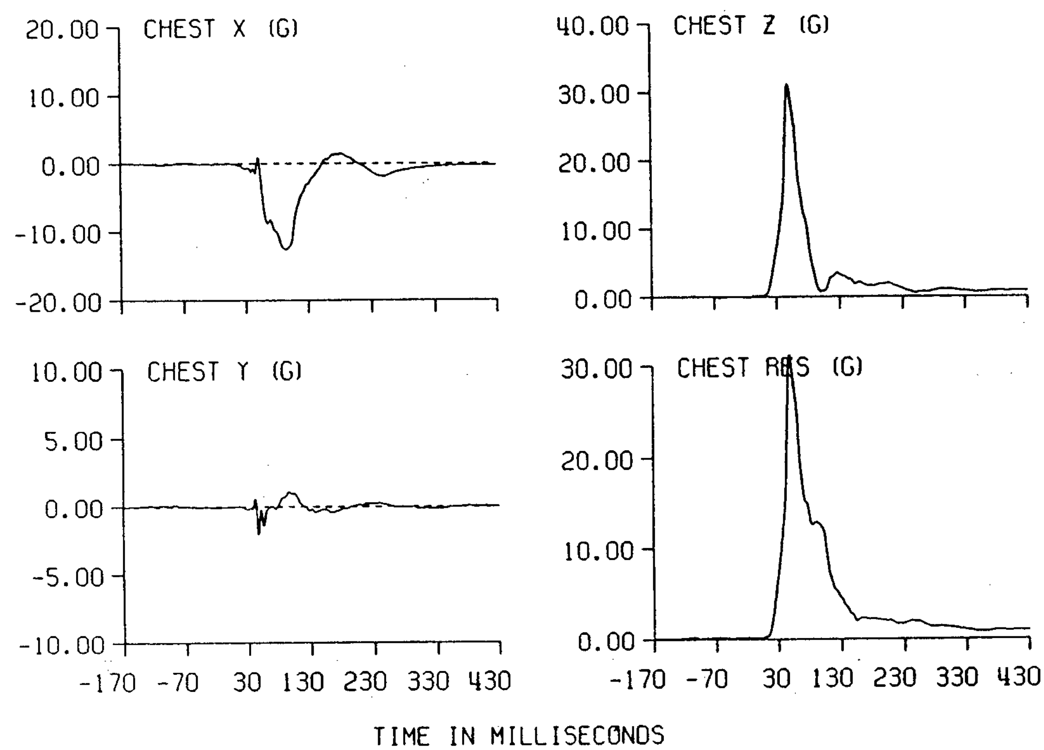
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



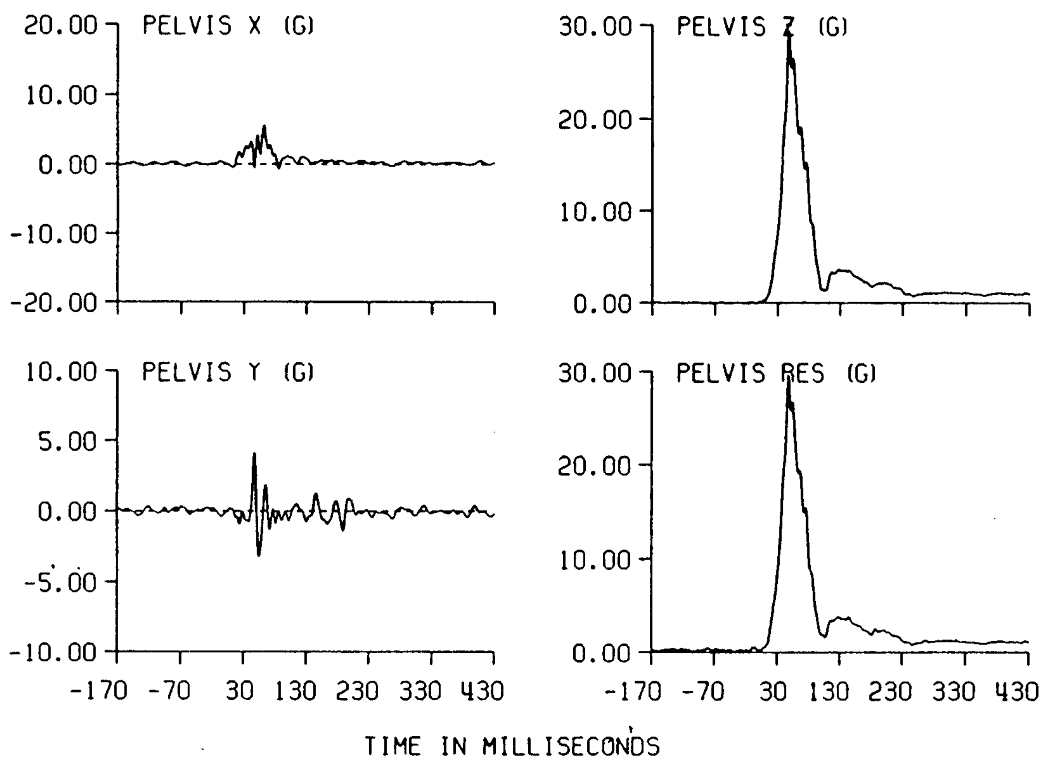
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



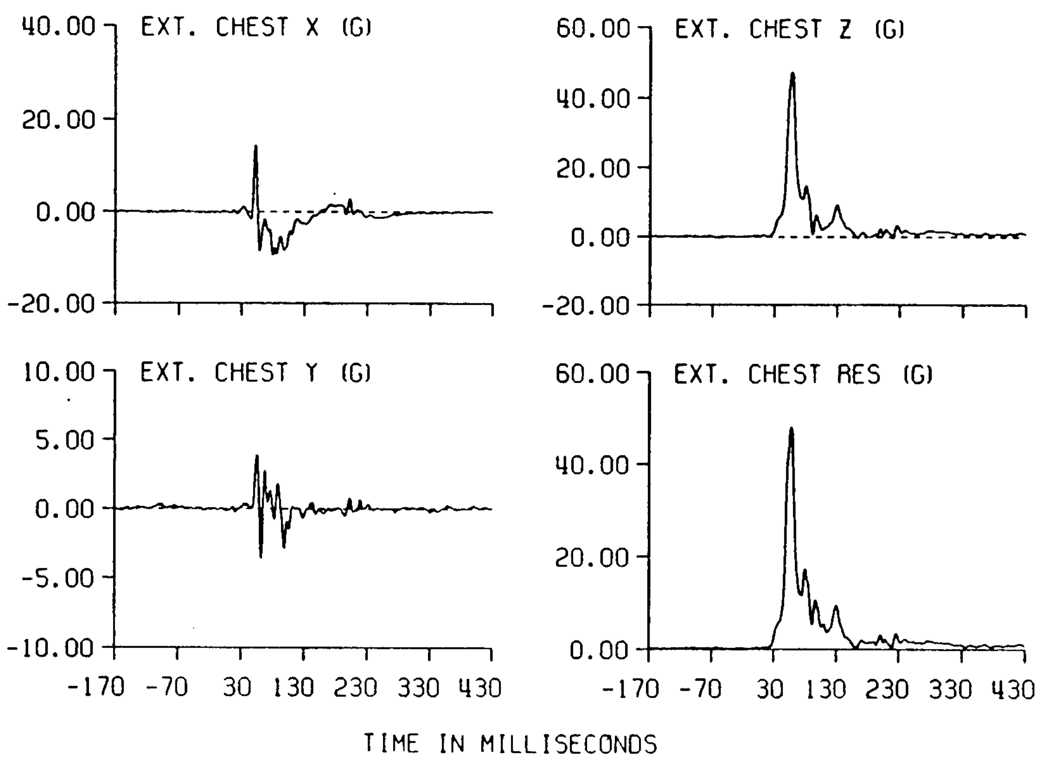
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D

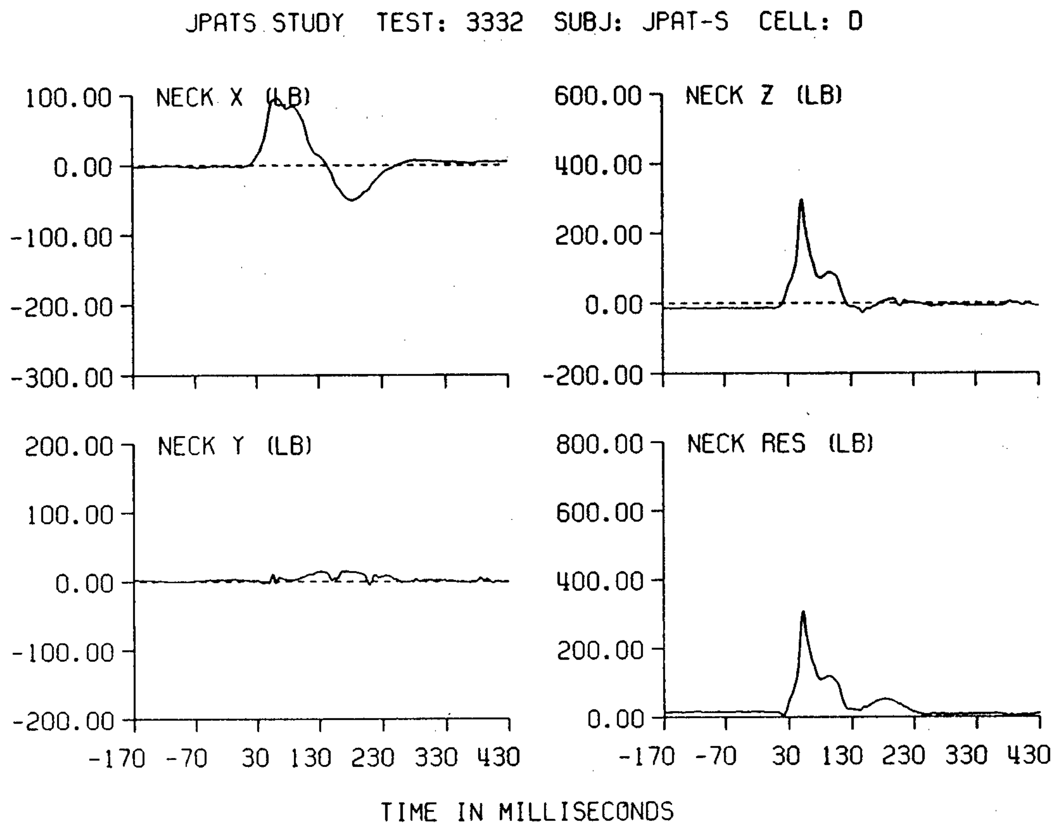


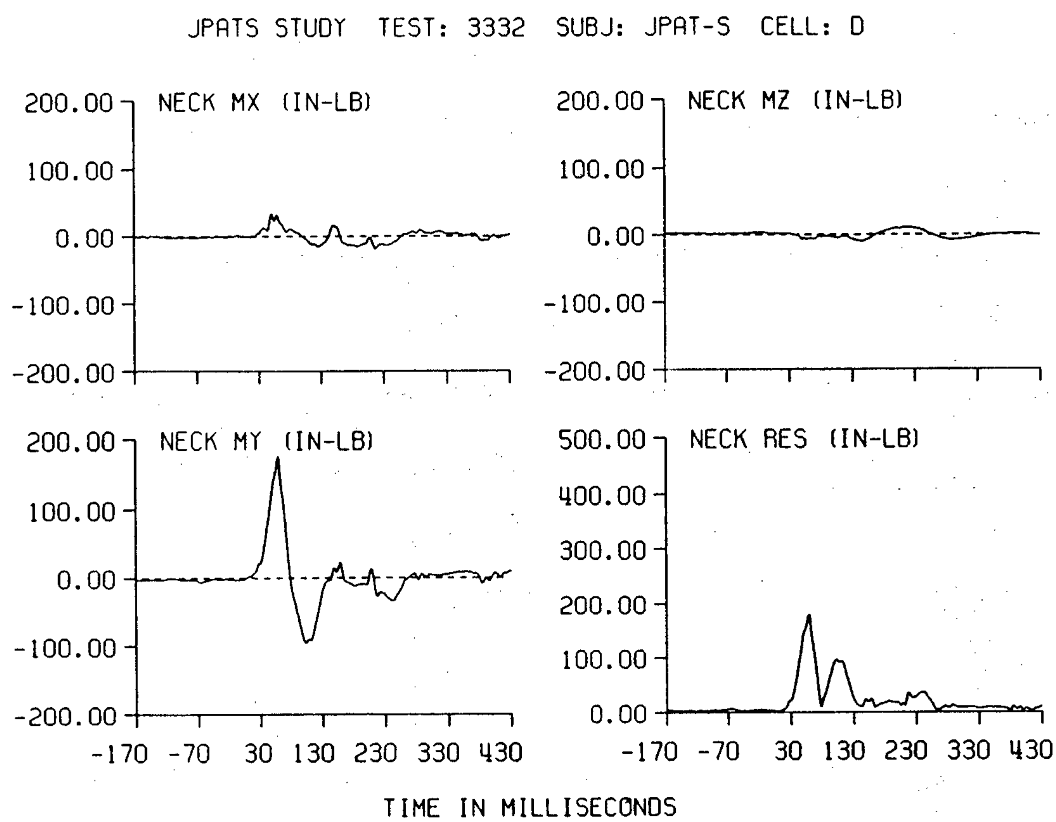
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



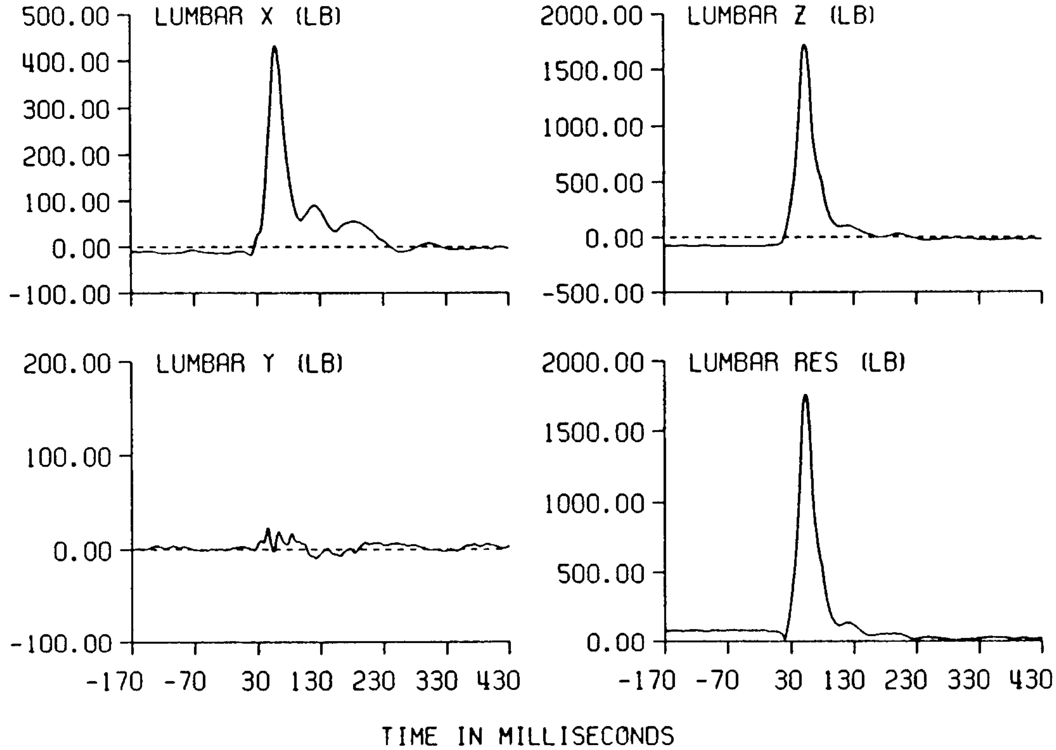
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



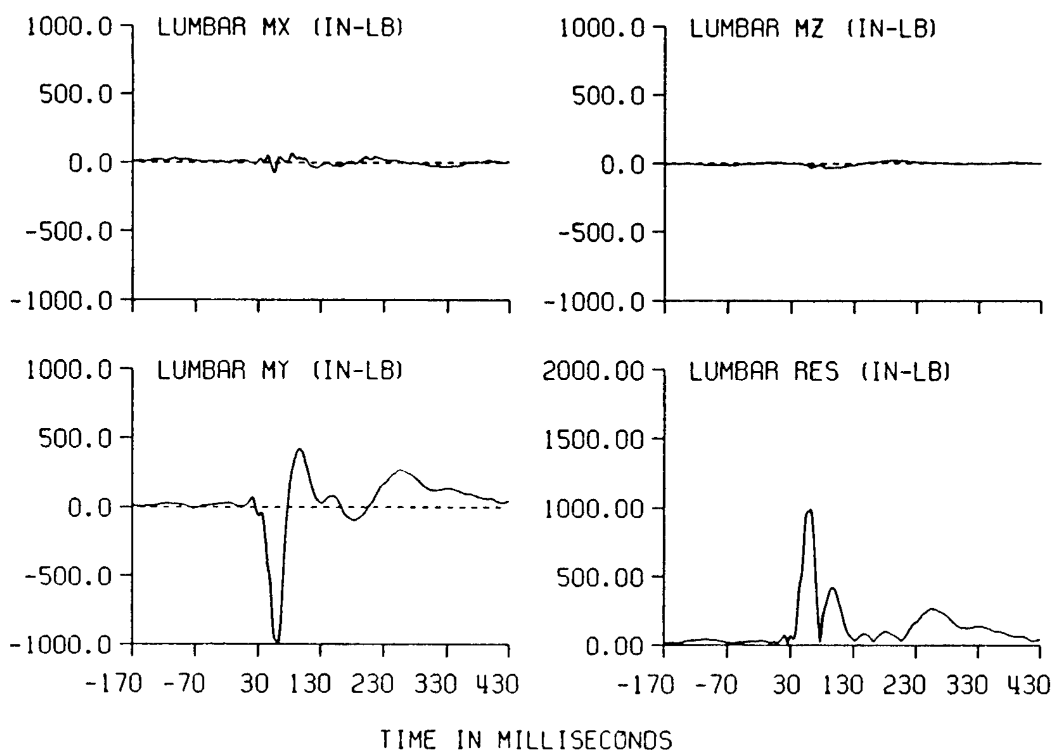

JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-170 -70 30 130 230 330 430
-170 -70 30 130 230 330 430
TIME IN MILLISECONDS


JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
500.00
400.00
300.00
200.00
100.00
0.00
-170 -70 30 130 230 330 430
-170 -70 30 130 230 330 430
TIME IN MILLISECONDS

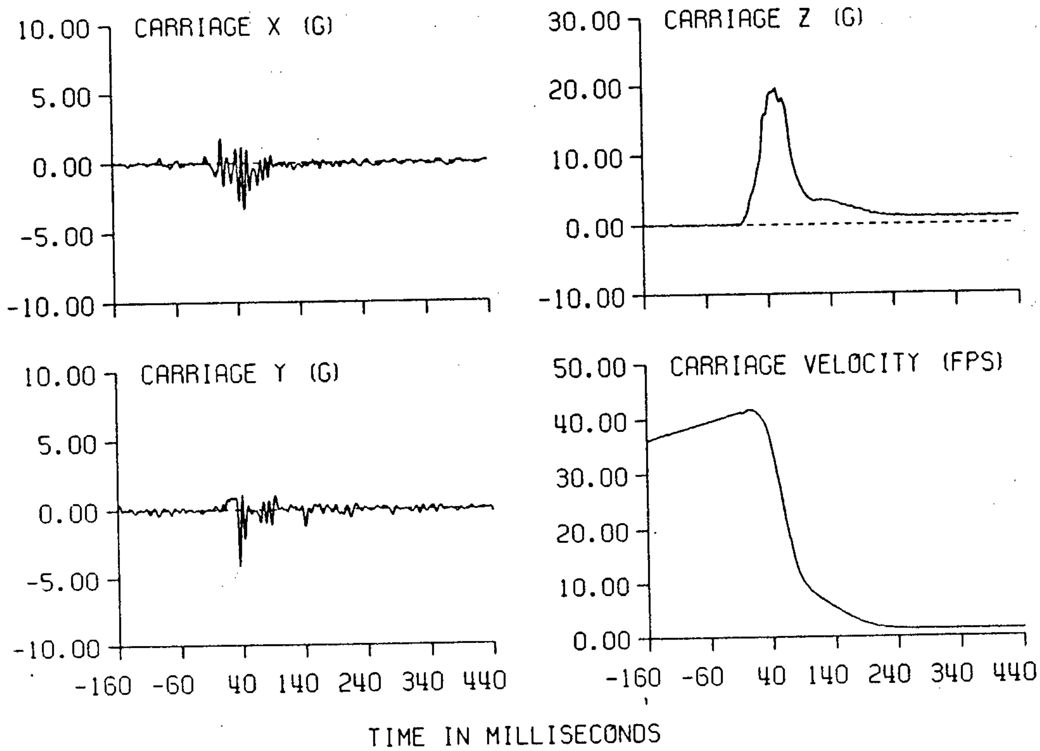
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



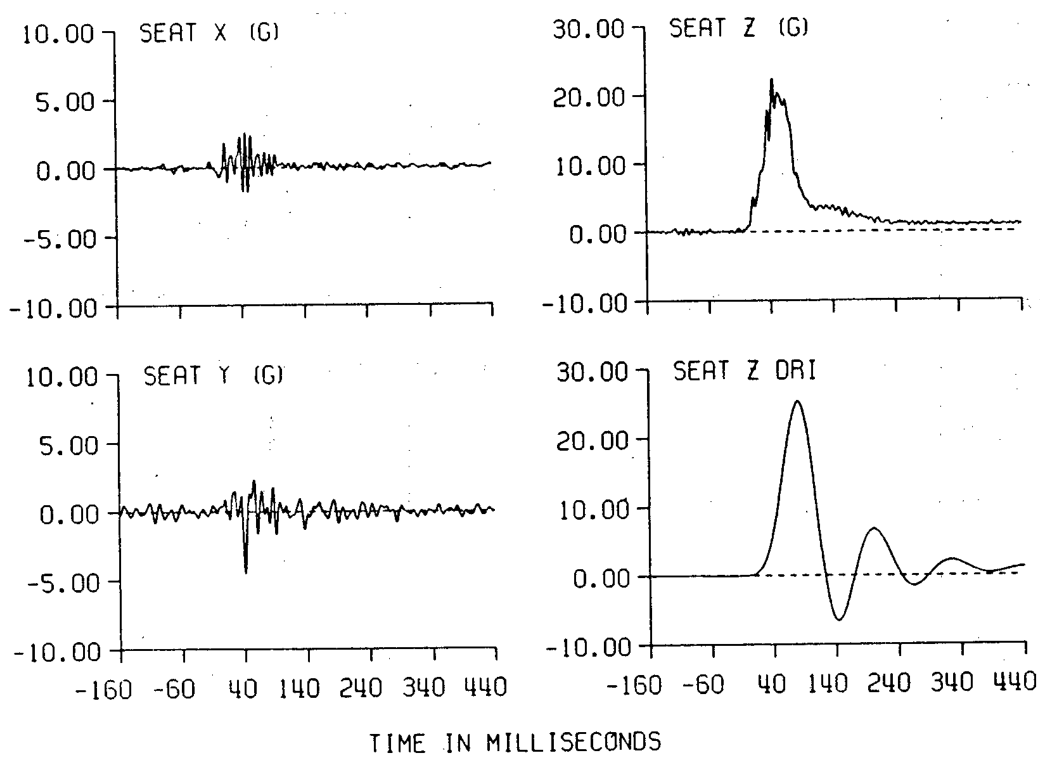
JPATS STUDY TEST: 3332 SUBJ: JPAT-S CELL: D



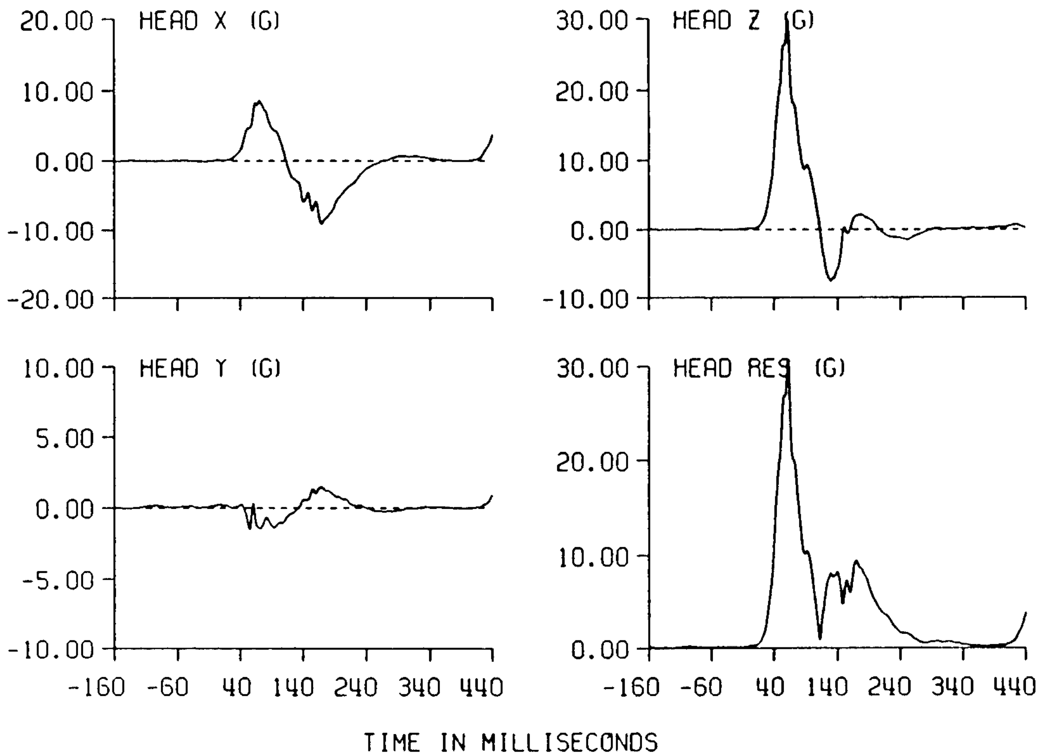
JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D



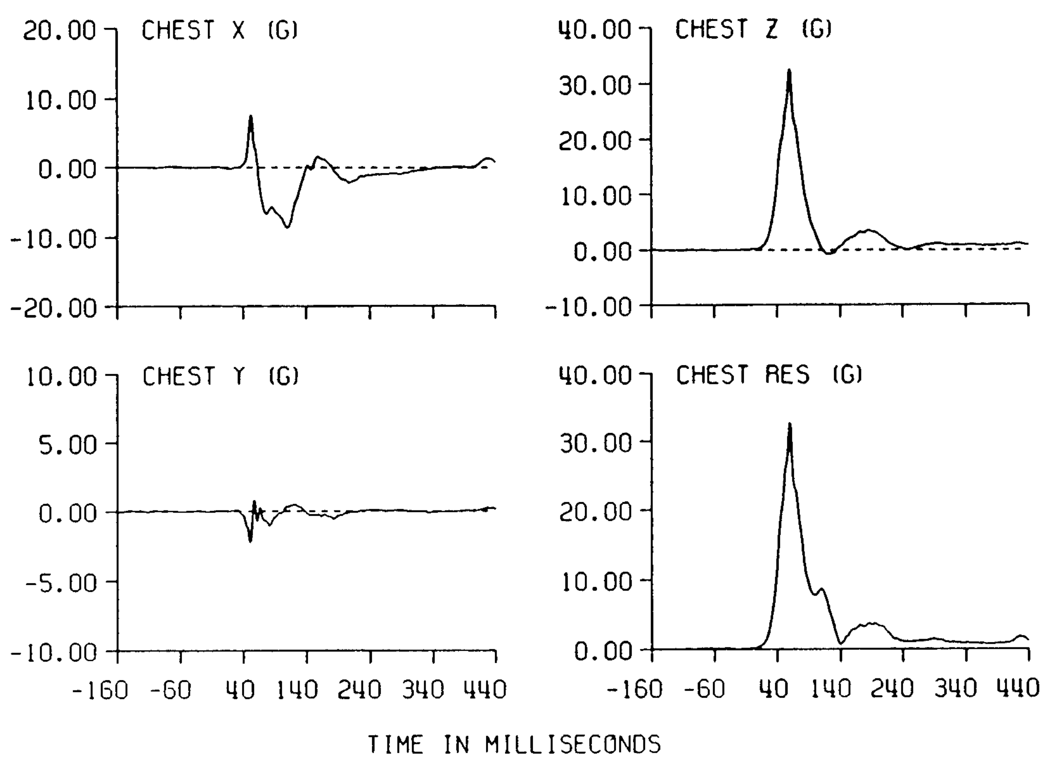
JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D



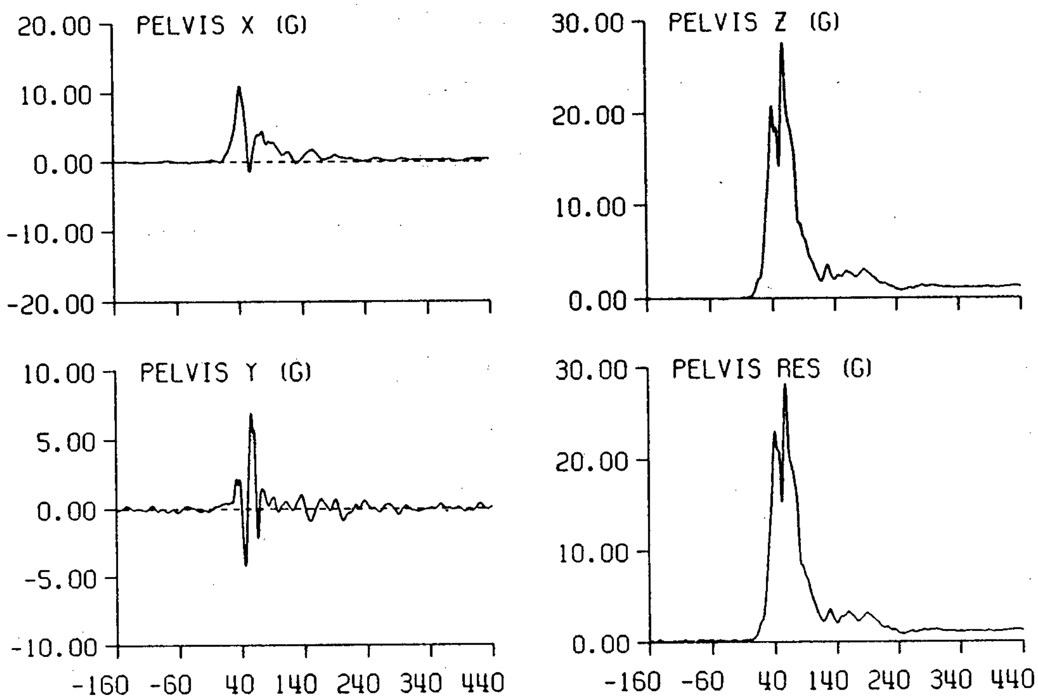
JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D



JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D

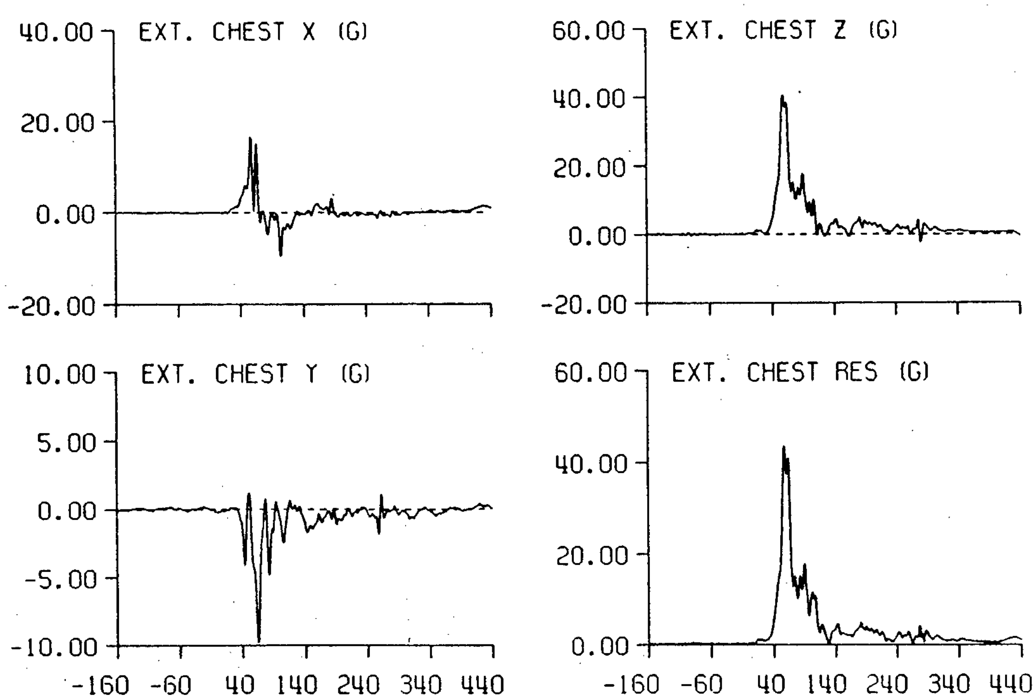


JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D

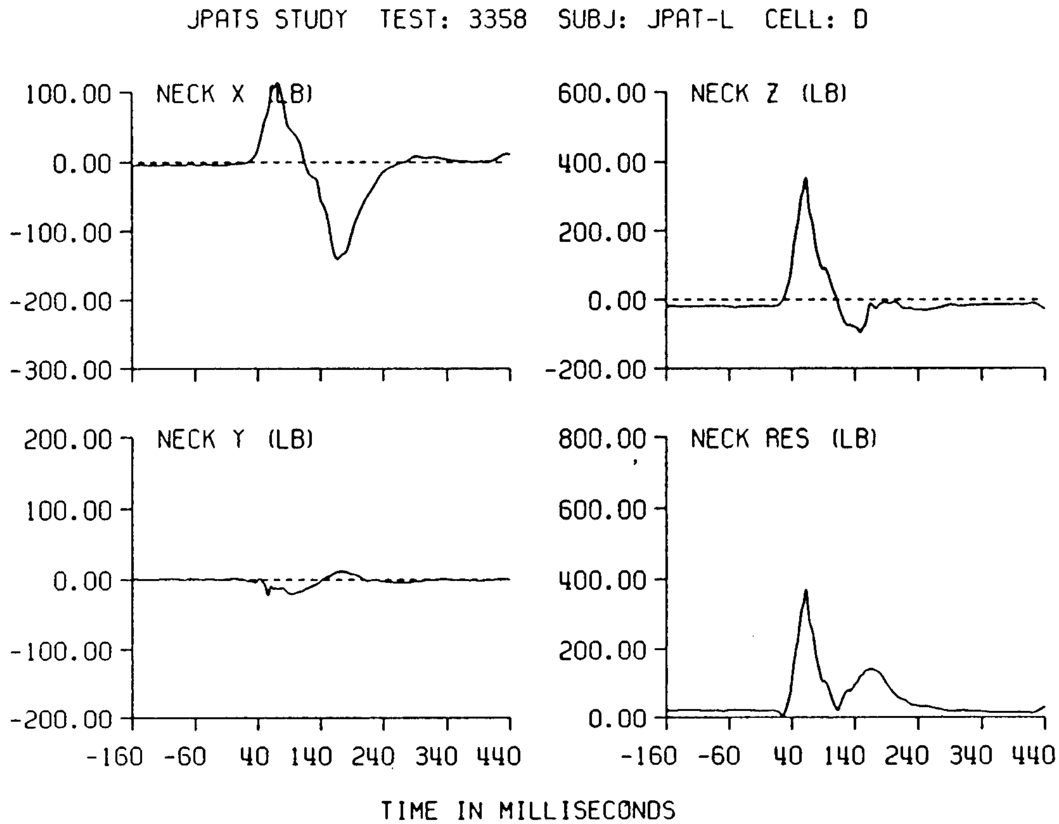


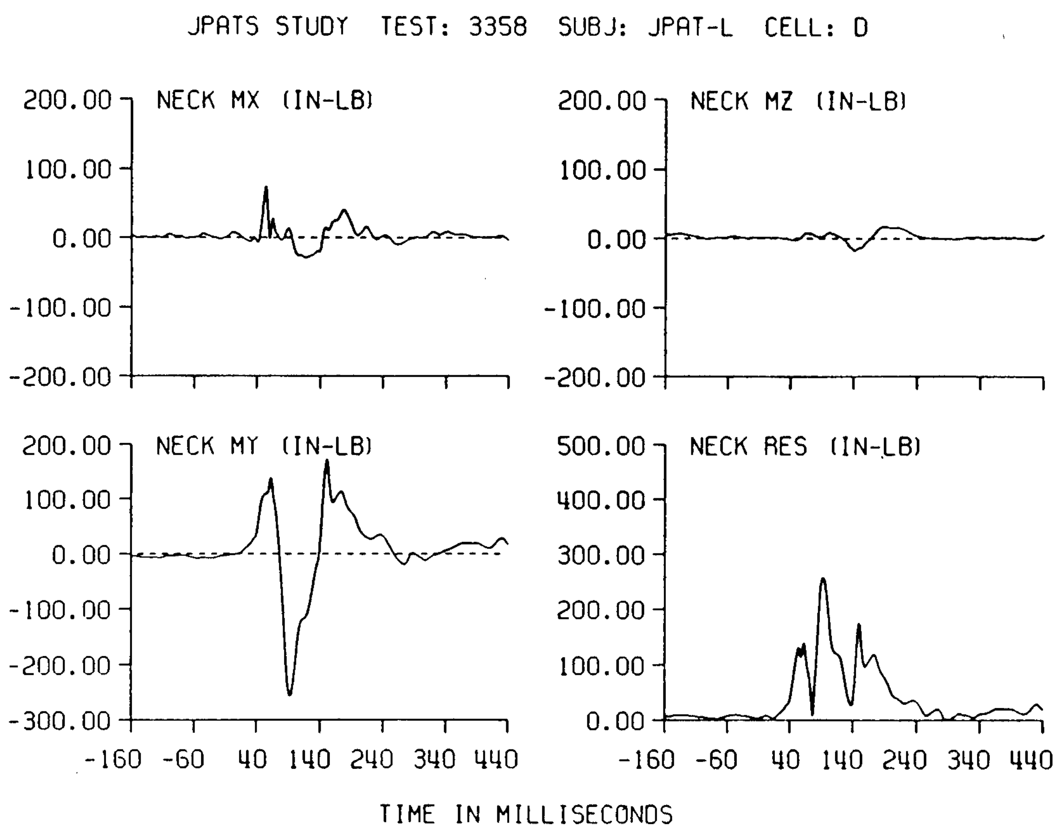
TIME IN MILLISECONDS

JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D

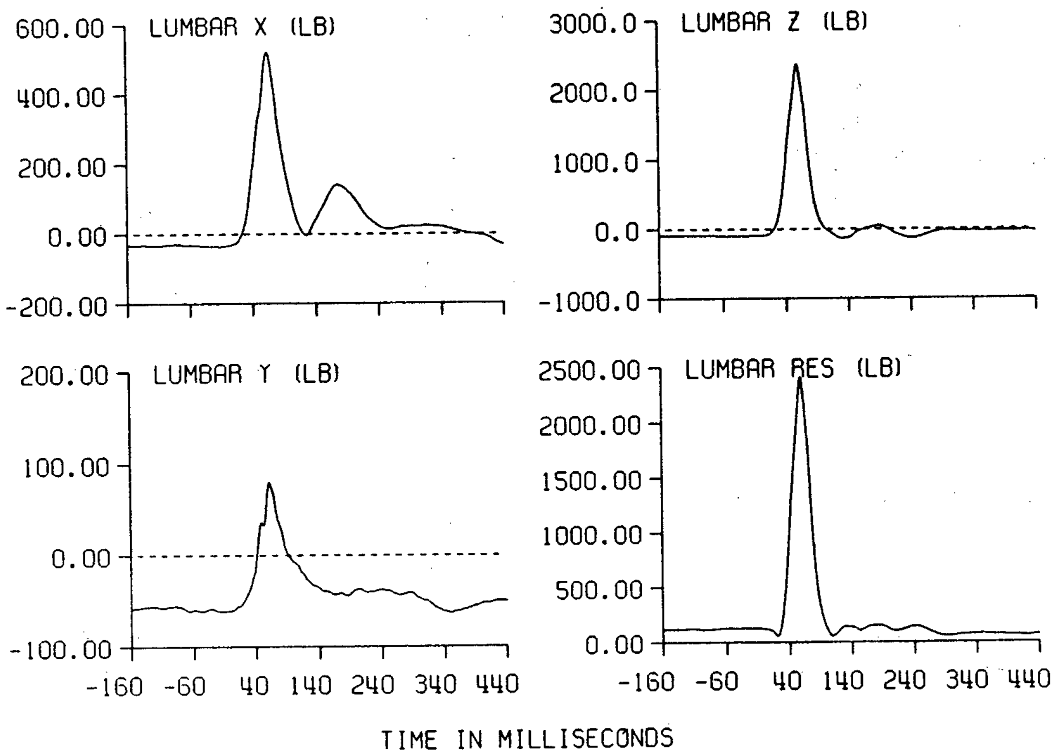


TIME IN MILLISECONDS

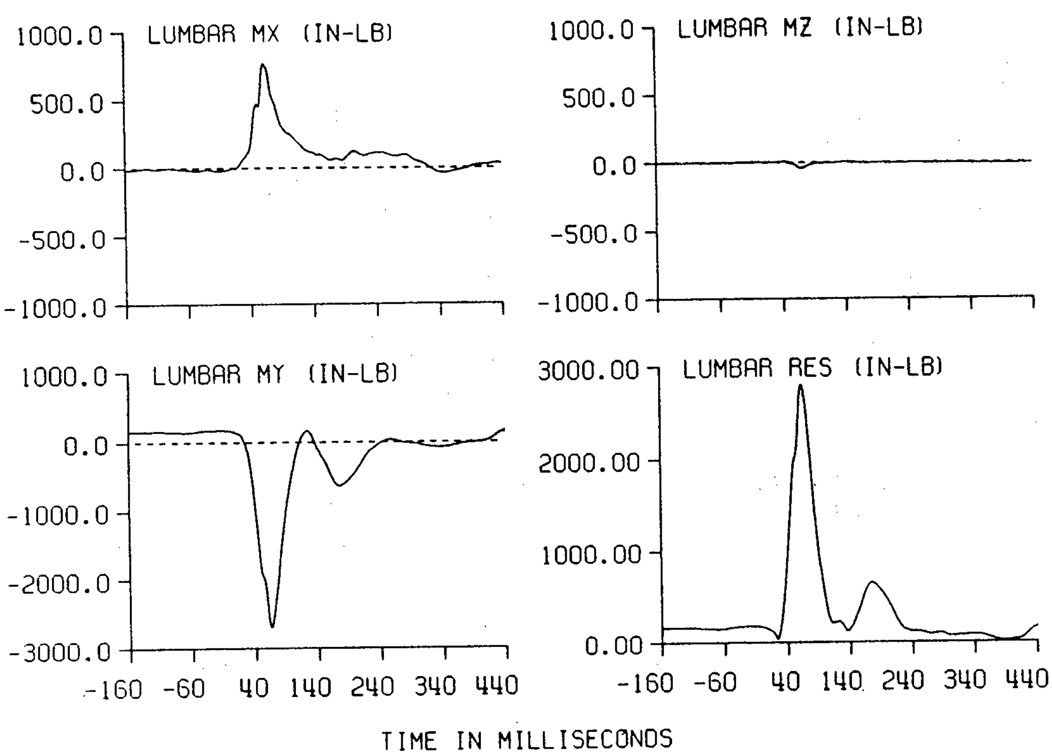

JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-160 -60 40 140 240 340 440
-160 -60 40 140 240 340 440
TIME IN MILLISECONDS

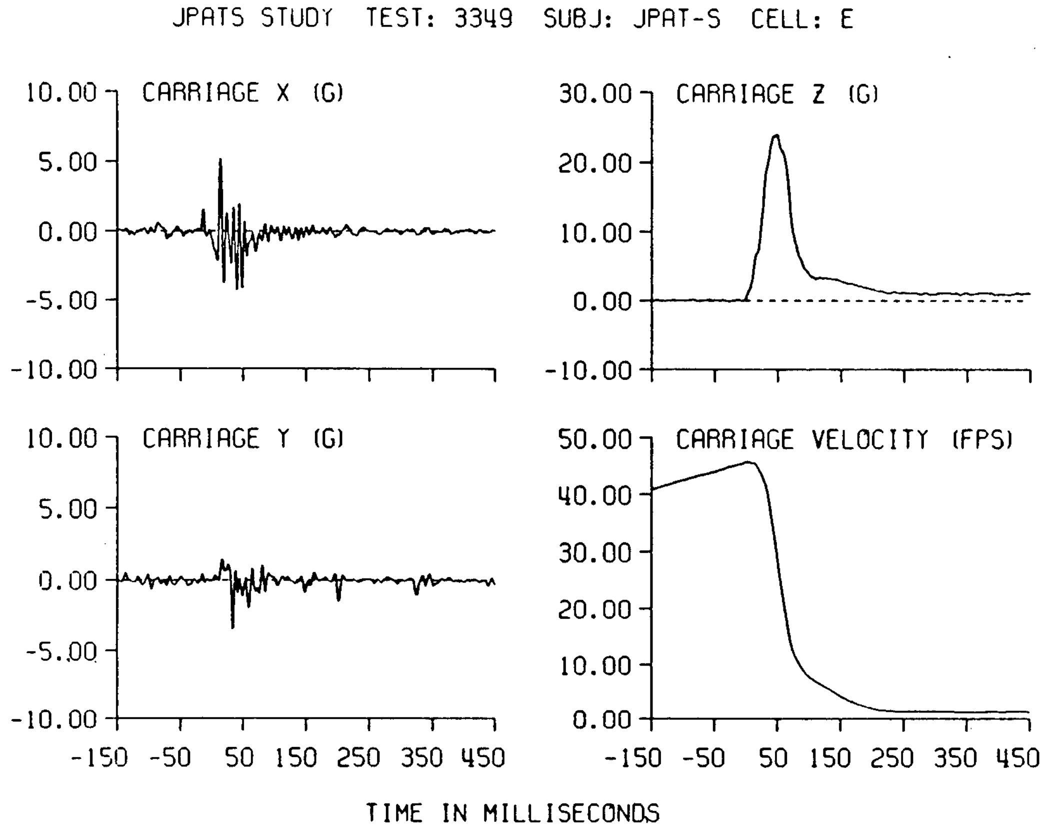

JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
-300.00
500.00
400.00
300.00
200.00
100.00
0.00
-160 -60 40 140 240 340 440
-160 -60 40 140 240 340 440
TIME IN MILLISECONDS

JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D

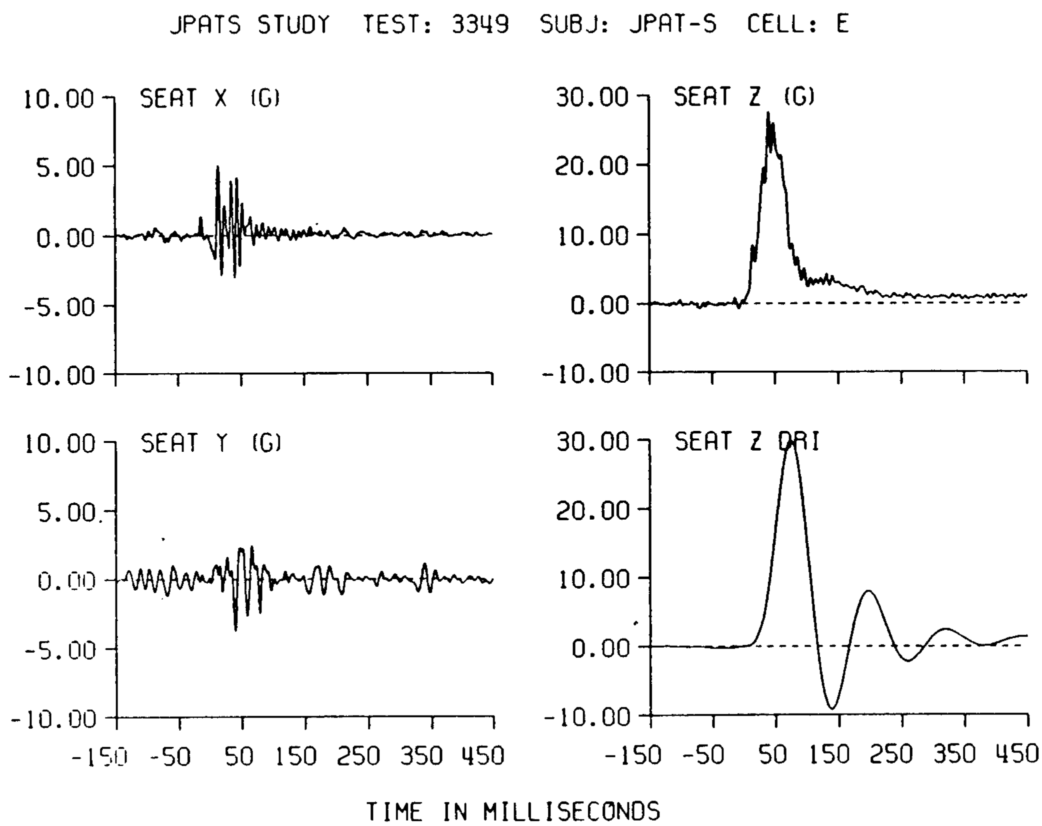


JPATS STUDY TEST: 3358 SUBJ: JPAT-L CELL: D

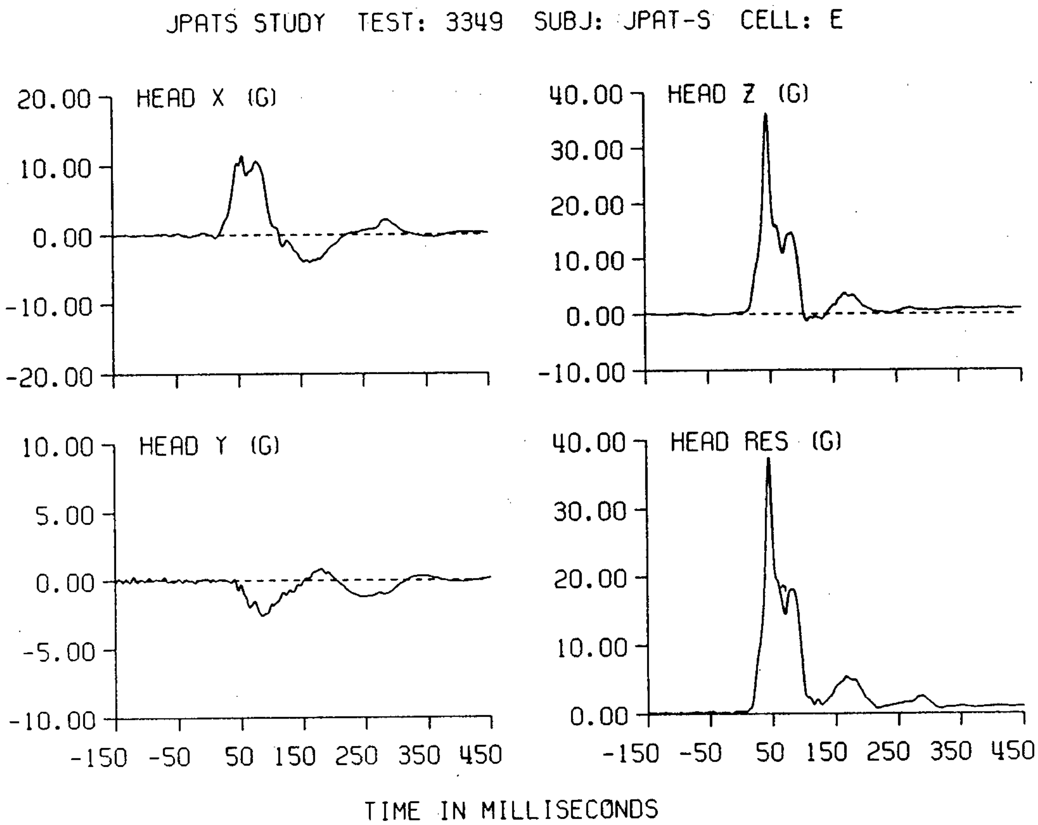


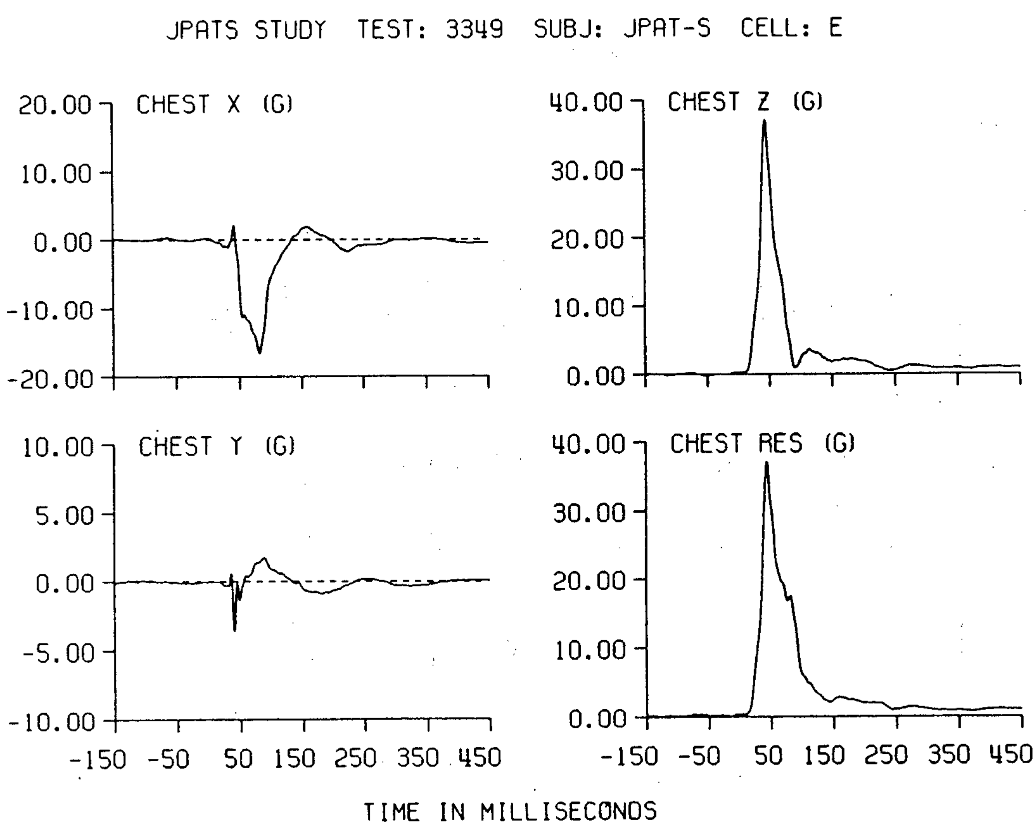


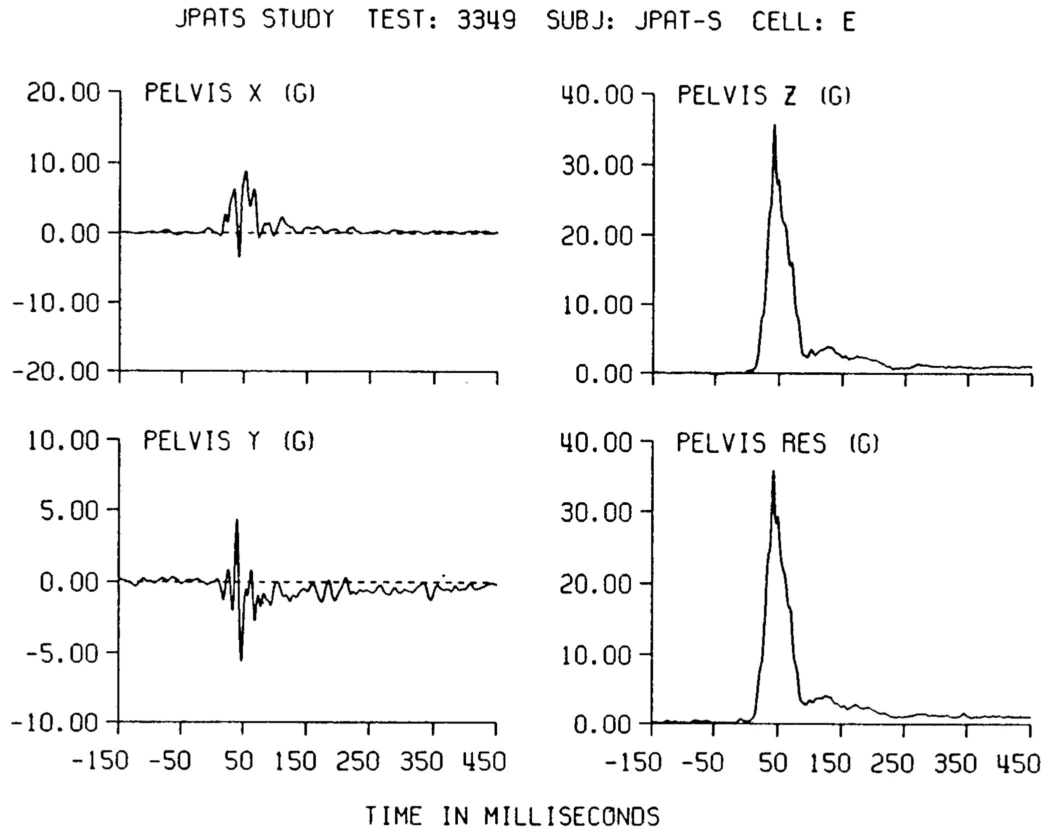
JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
CARRIAGE X (G)
CARRIAGE Z (G)
CARRIAGE Y (G)
CARRIAGE VELOCITY (FPS)
TIME IN MILLISECONDS

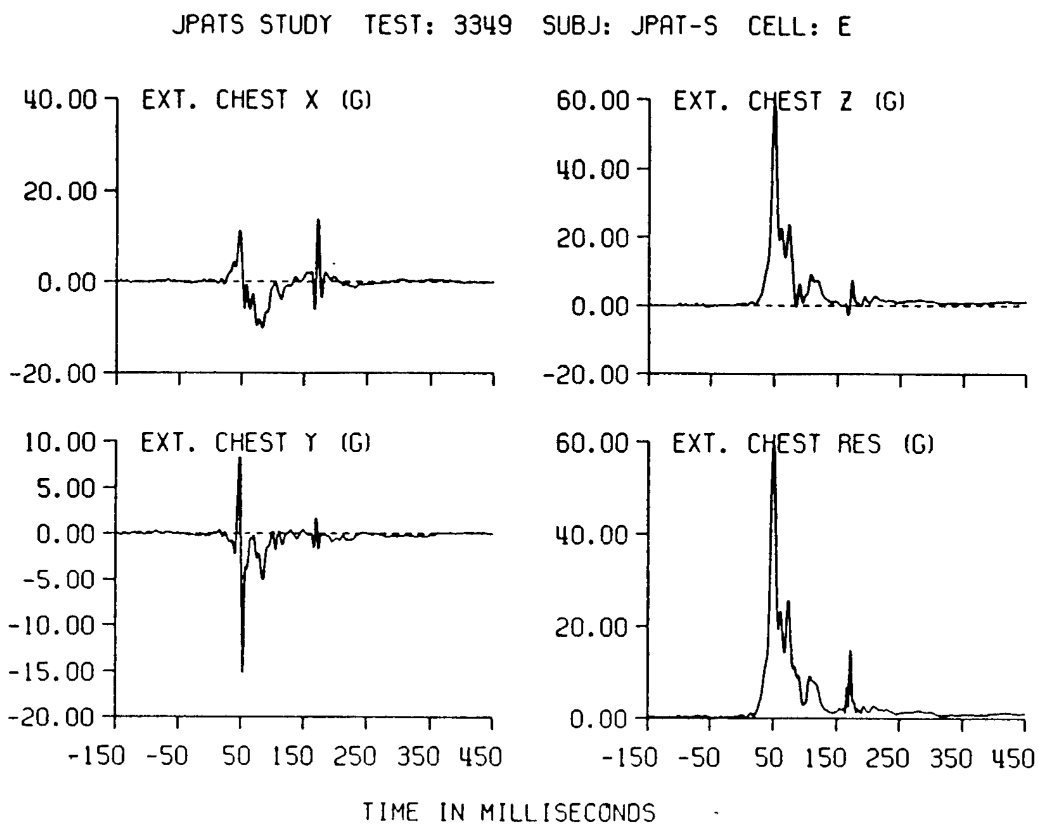


JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
SEAT X (G)
SEAT Z (G)
SEAT Y (G)
SEAT Z DRI
TIME IN MILLISECONDS

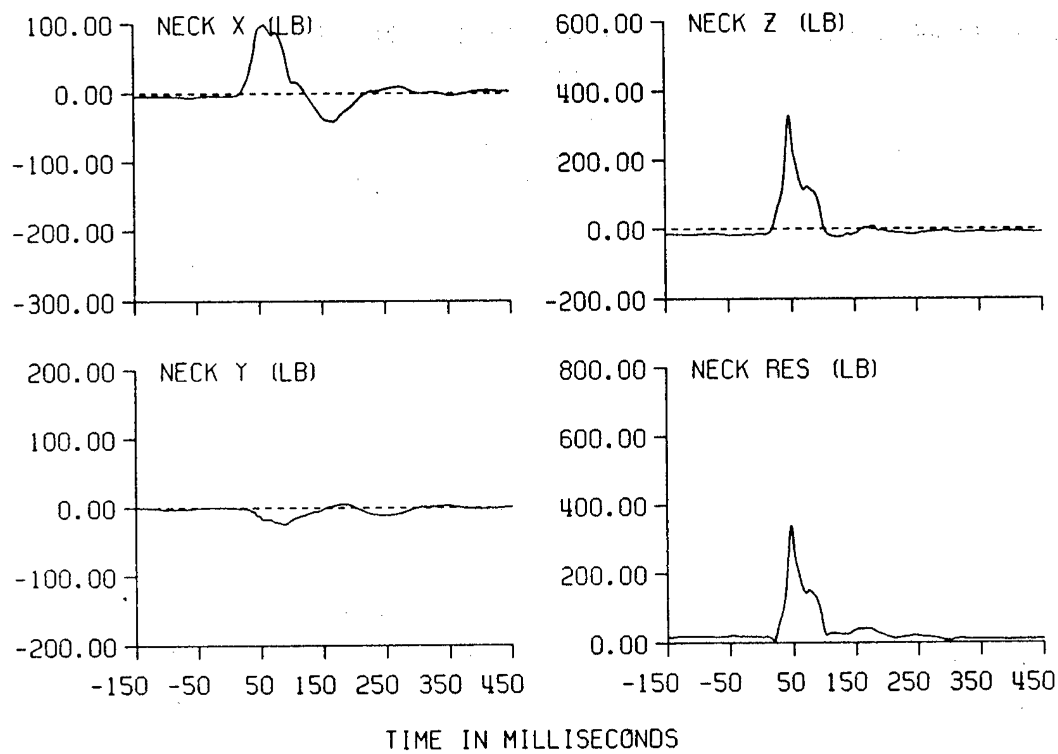

JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
HEAD X (G)
HEAD Z (G)
HEAD Y (G)
HEAD RES (G)
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS


JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
CHEST X (G)
CHEST Z (G)
CHEST Y (G)
CHEST RES (G)
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS

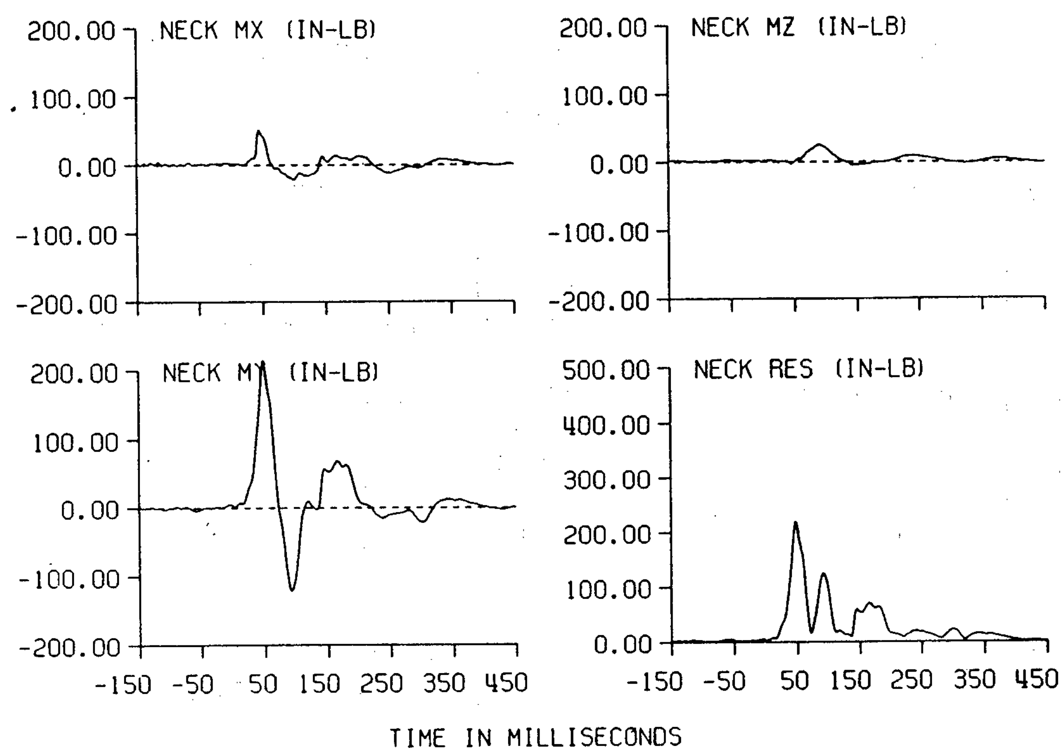

JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
PELVIS X (G)
PELVIS Z (G)
PELVIS Y (G)
PELVIS RES (G)
20.00
10.00
0.00
-10.00
-20.00
40.00
30.00
20.00
10.00
0.00
5.00
-5.00
-10.00
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS

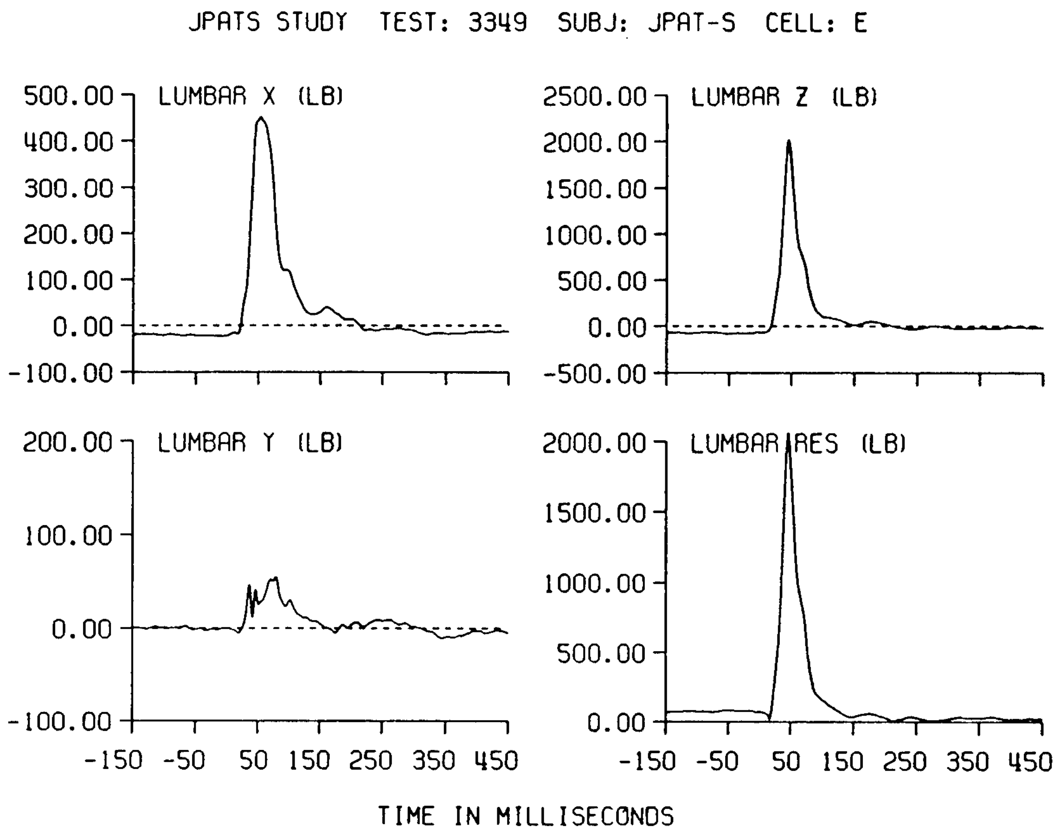

JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
EXT. CHEST X (G)
EXT. CHEST Z (G)
EXT. CHEST Y (G)
EXT. CHEST RES (G)
40.00
20.00
0.00
-20.00
60.00
10.00
5.00
-5.00
-10.00
-15.00
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS

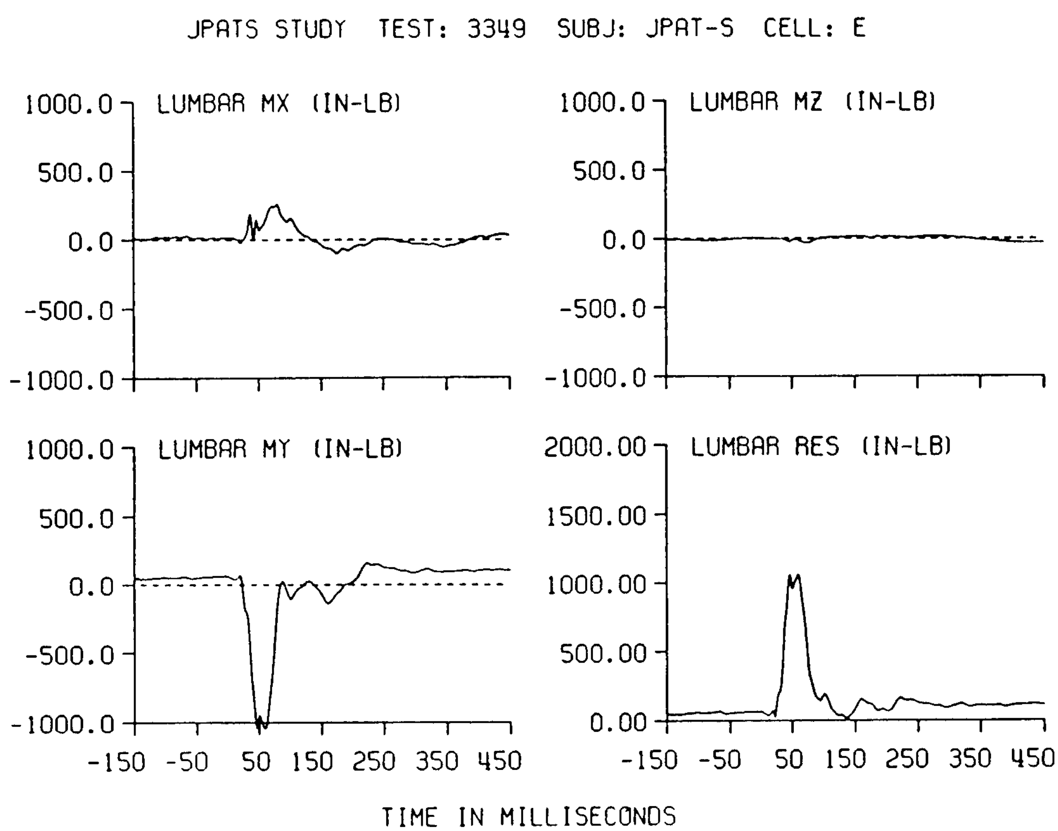
JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E



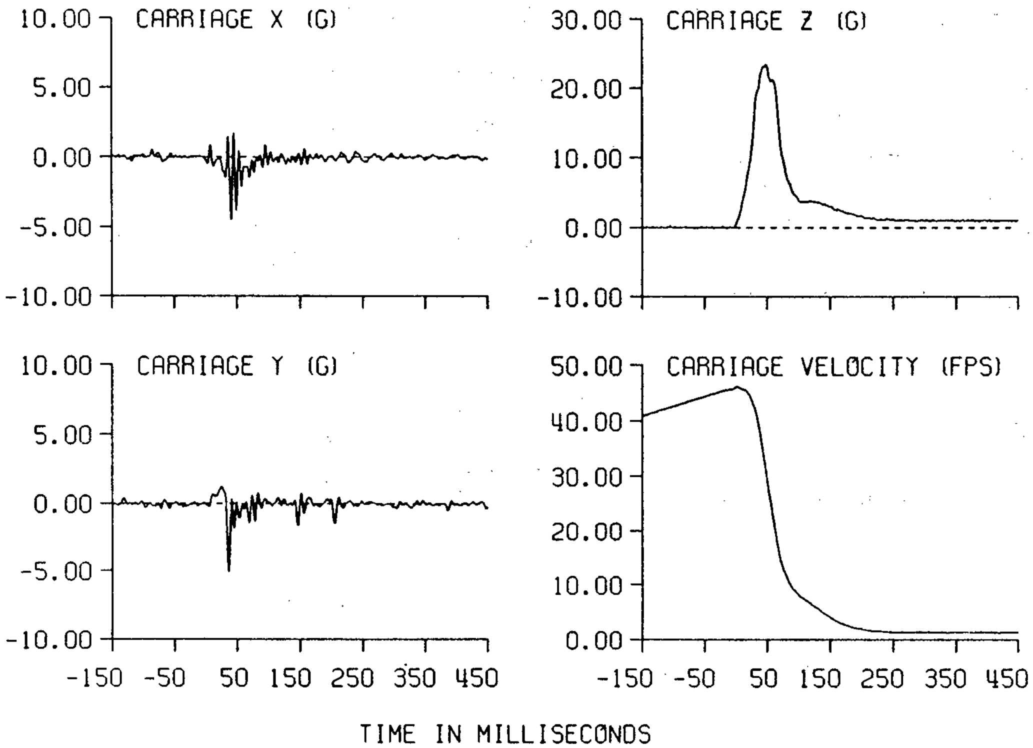
JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E



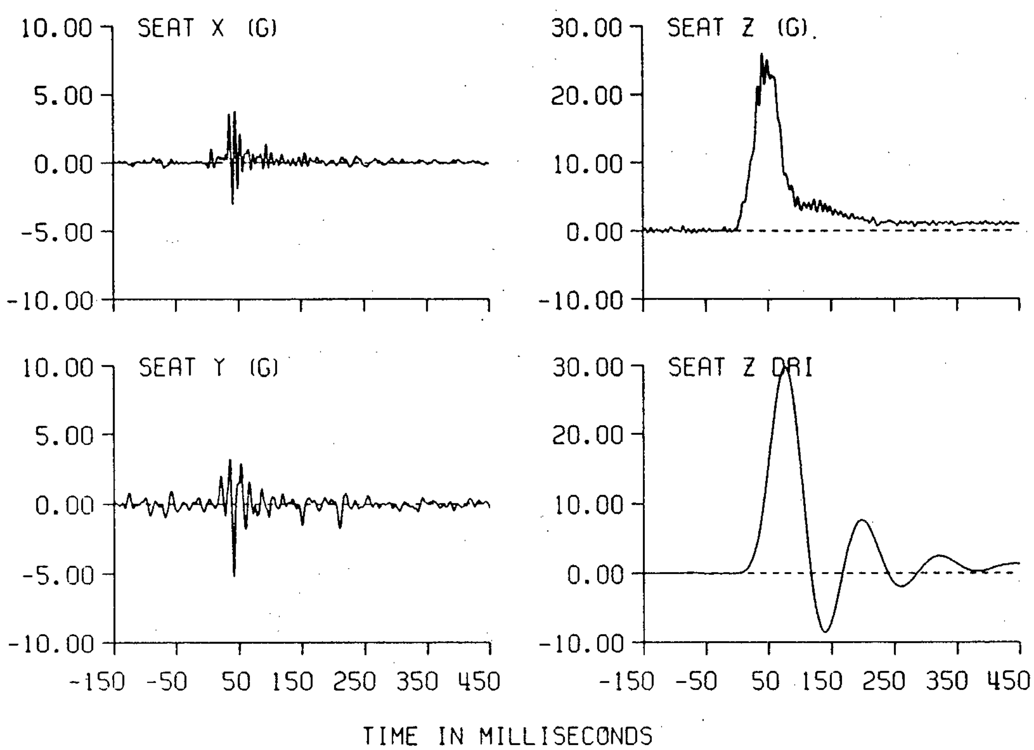

JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
LUMBAR X (LB)
LUMBAR Z (LB)
LUMBAR Y (LB)
LUMBAR RES (LB)
TIME IN MILLISECONDS


JPATS STUDY TEST: 3349 SUBJ: JPAT-S CELL: E
LUMBAR MX (IN-LB)
LUMBAR MZ (IN-LB)
LUMBAR MY (IN-LB)
LUMBAR RES (IN-LB)
TIME IN MILLISECONDS

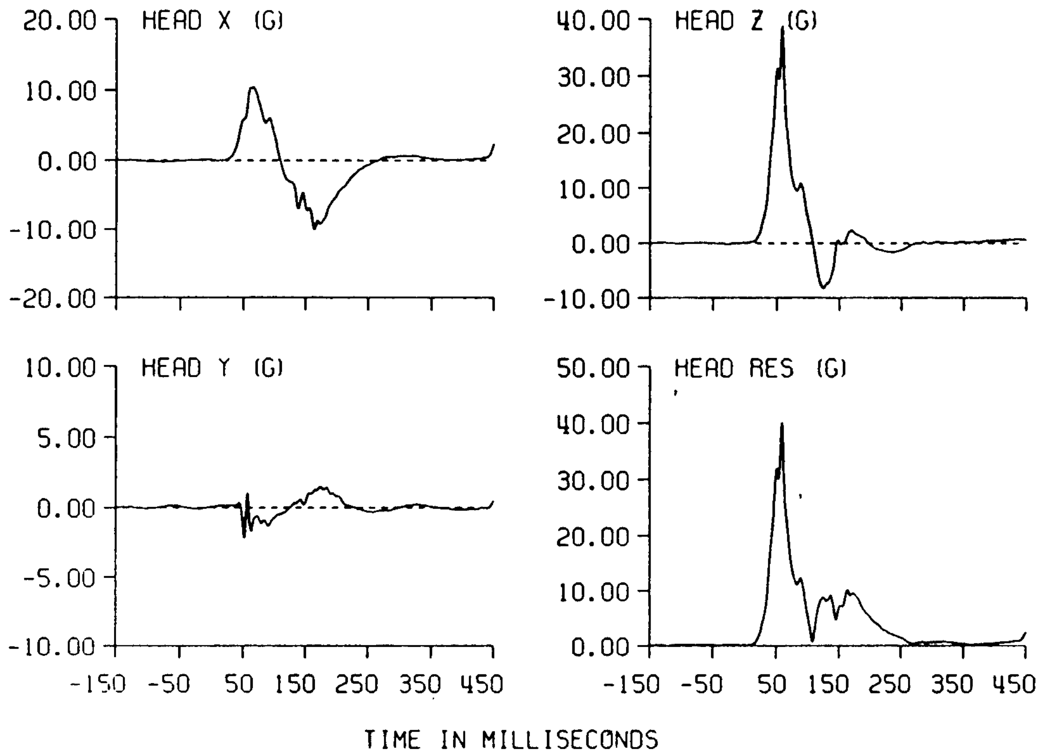
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



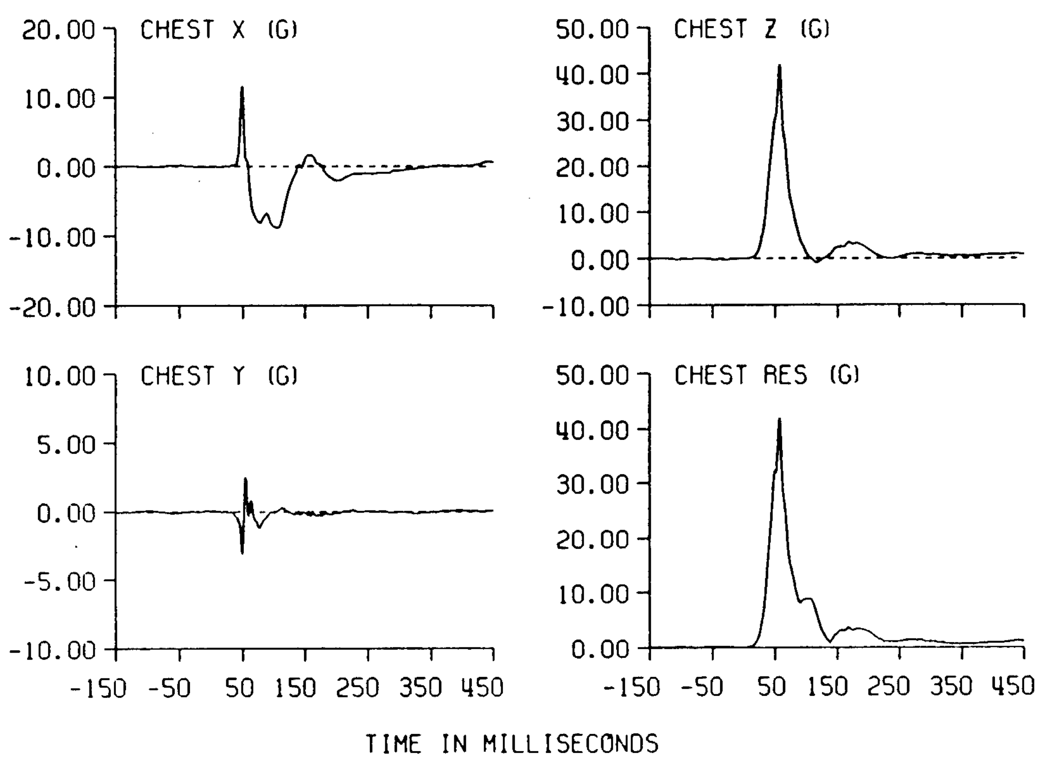
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



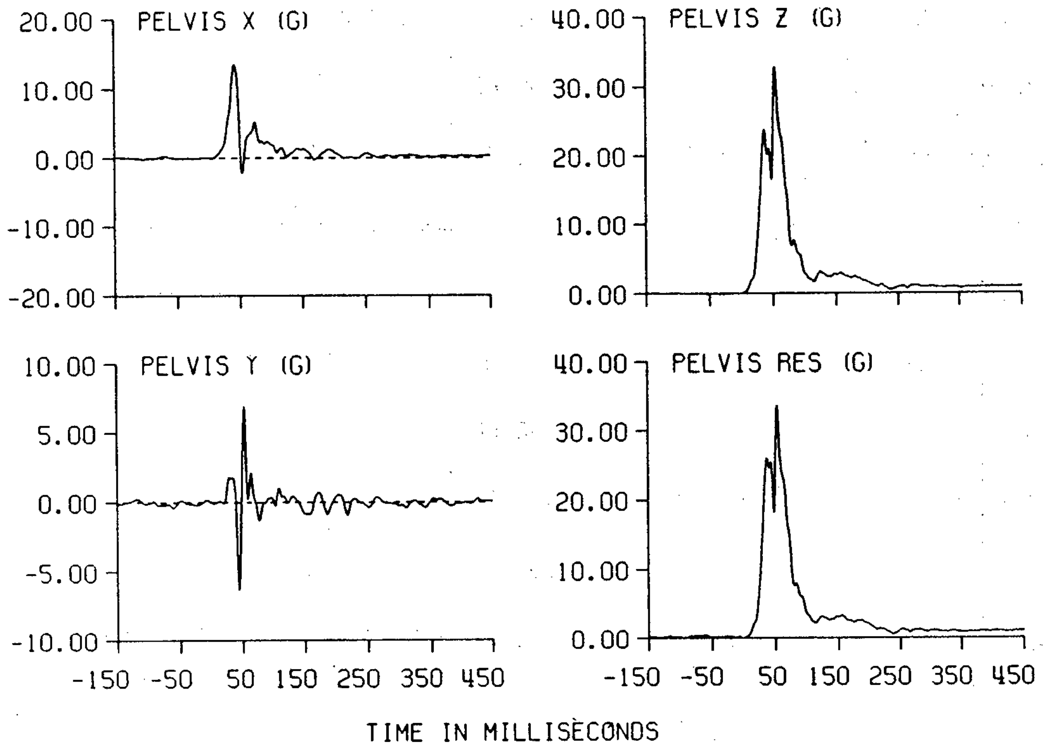
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



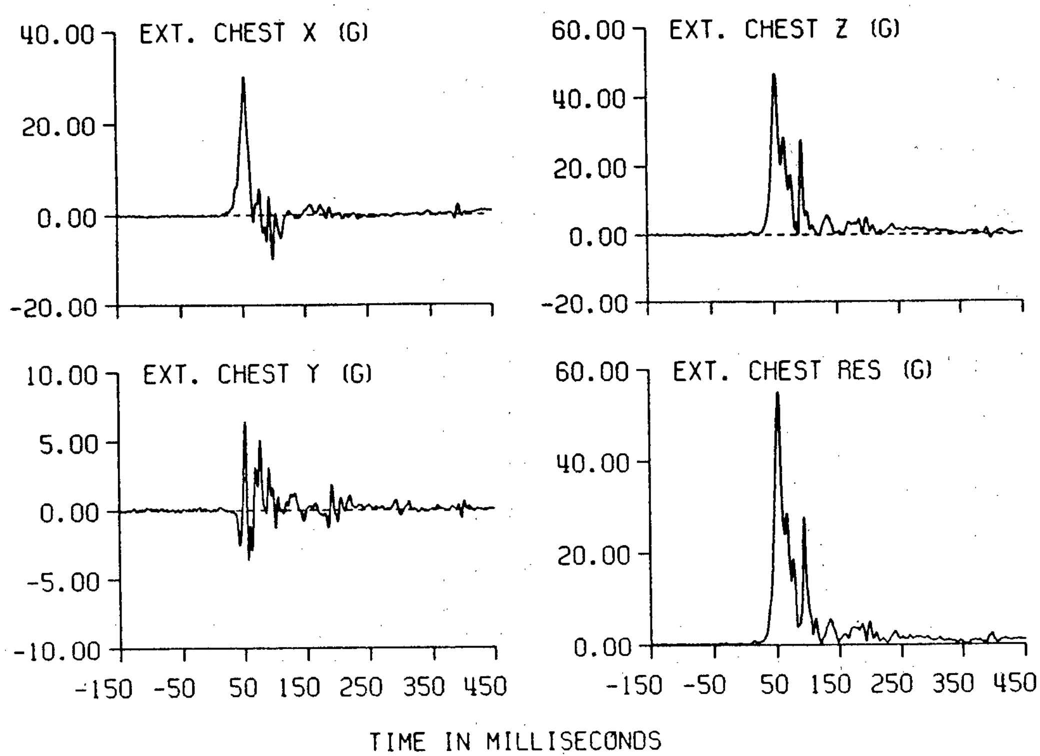
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



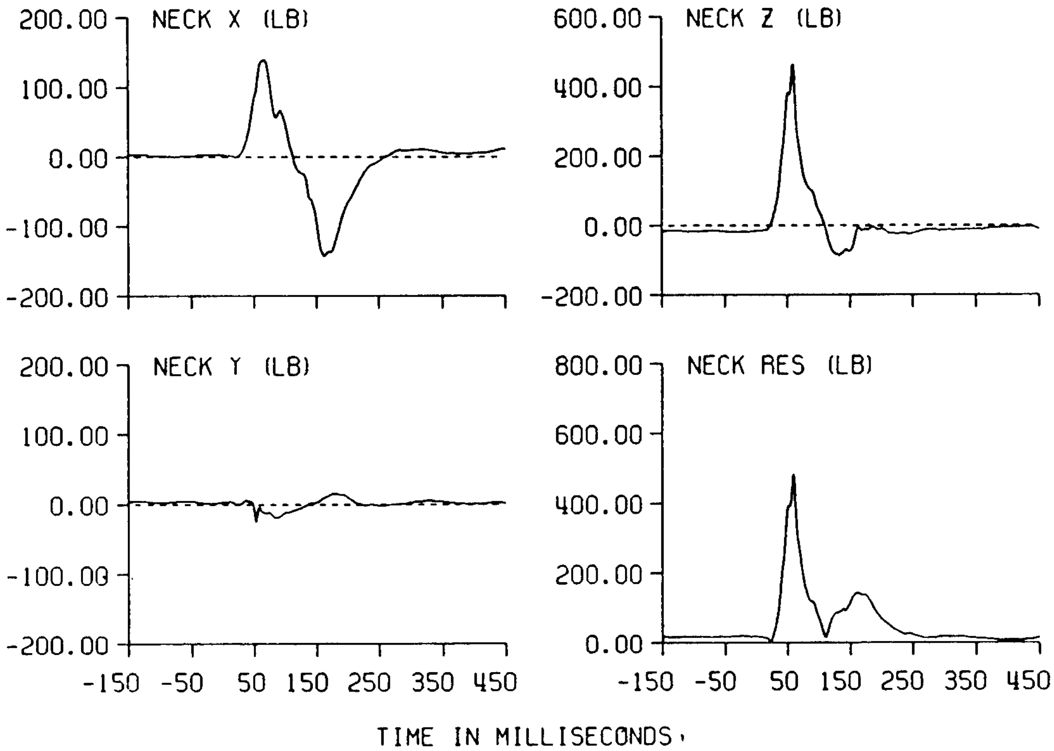
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



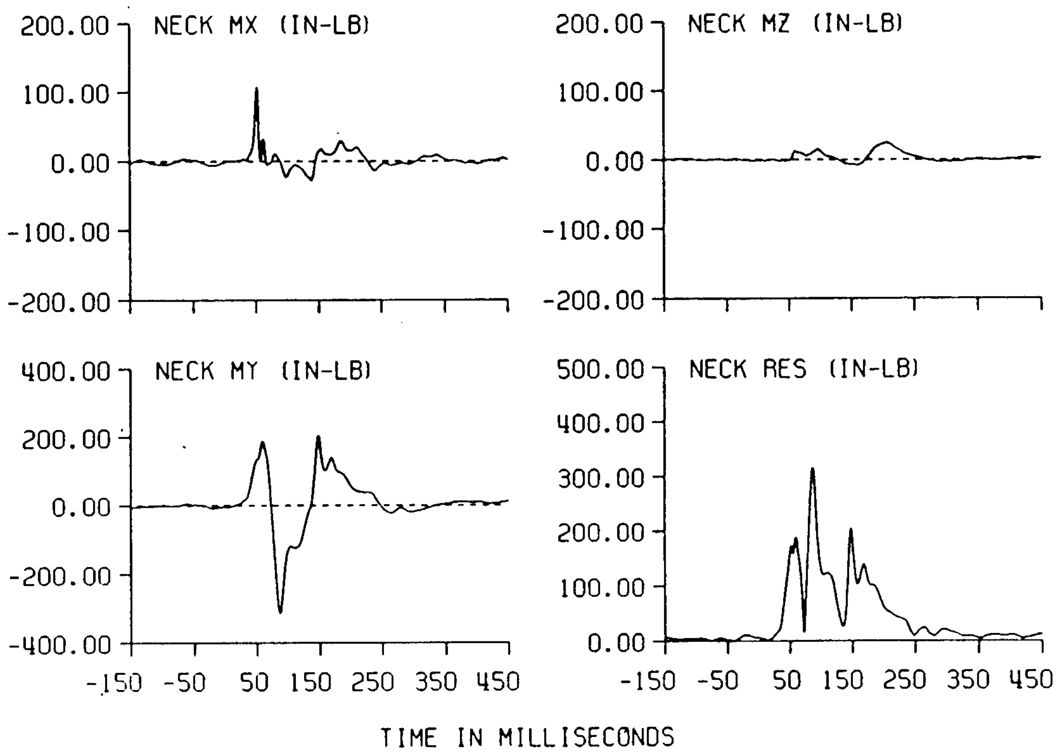
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



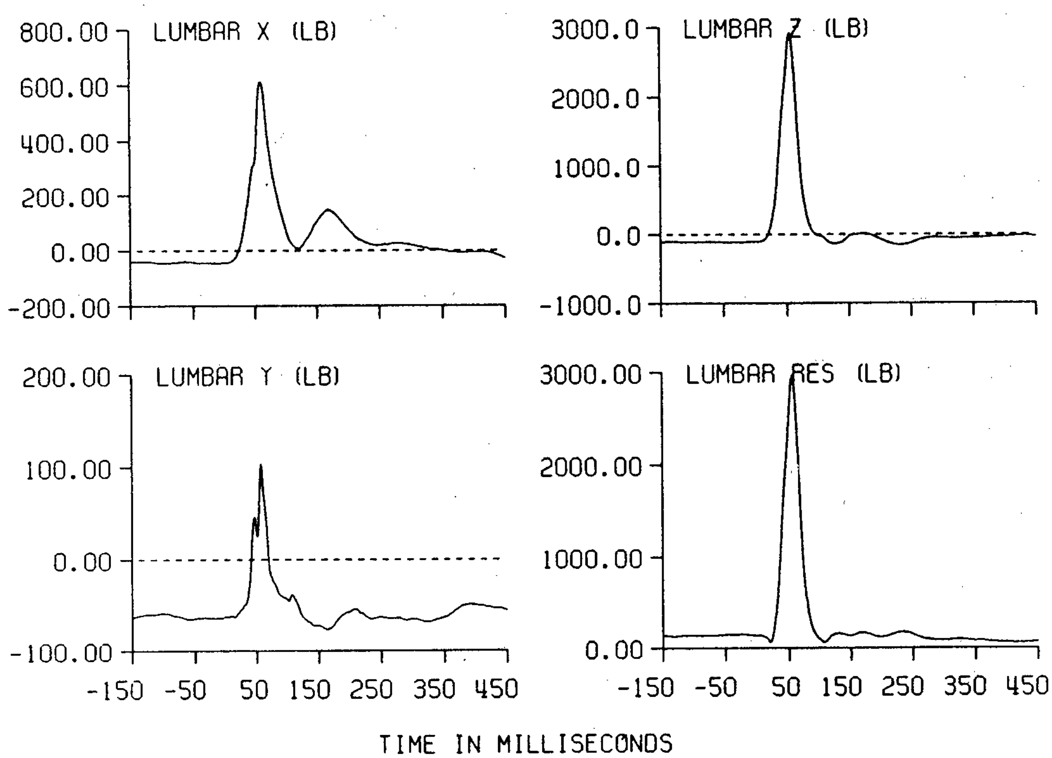
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



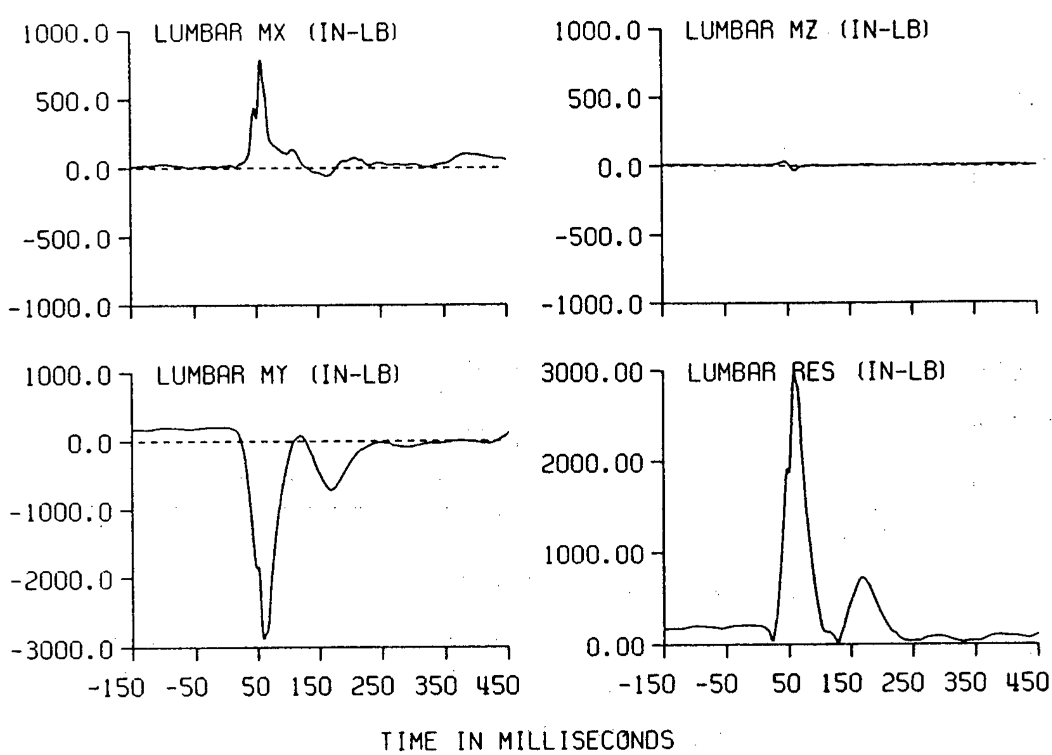
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



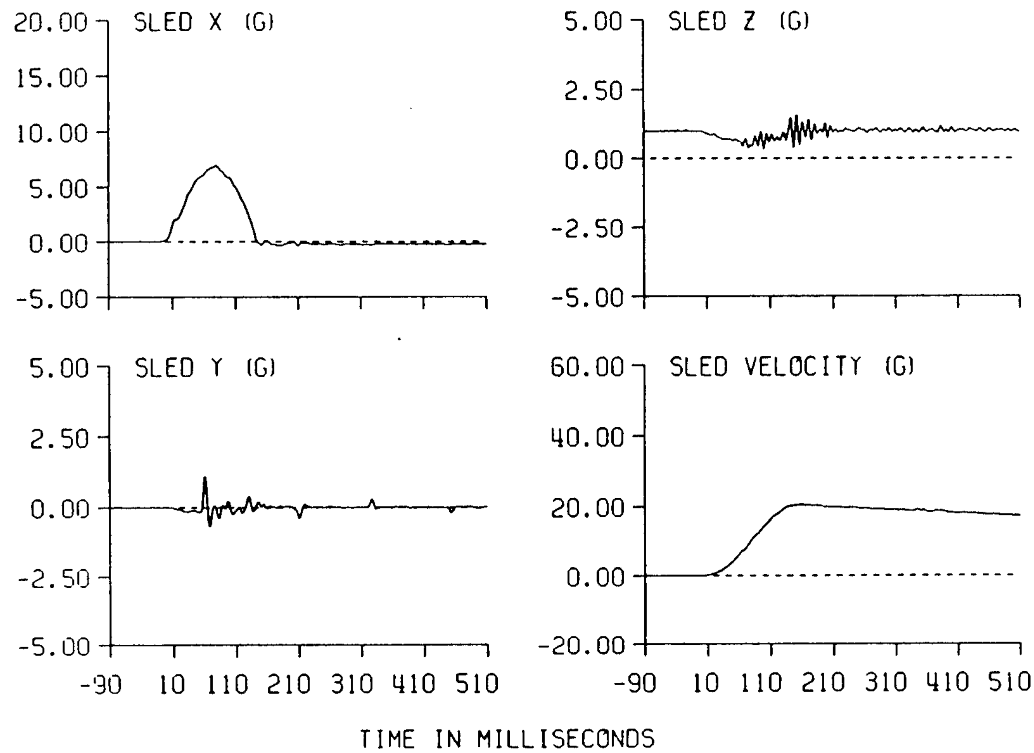
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



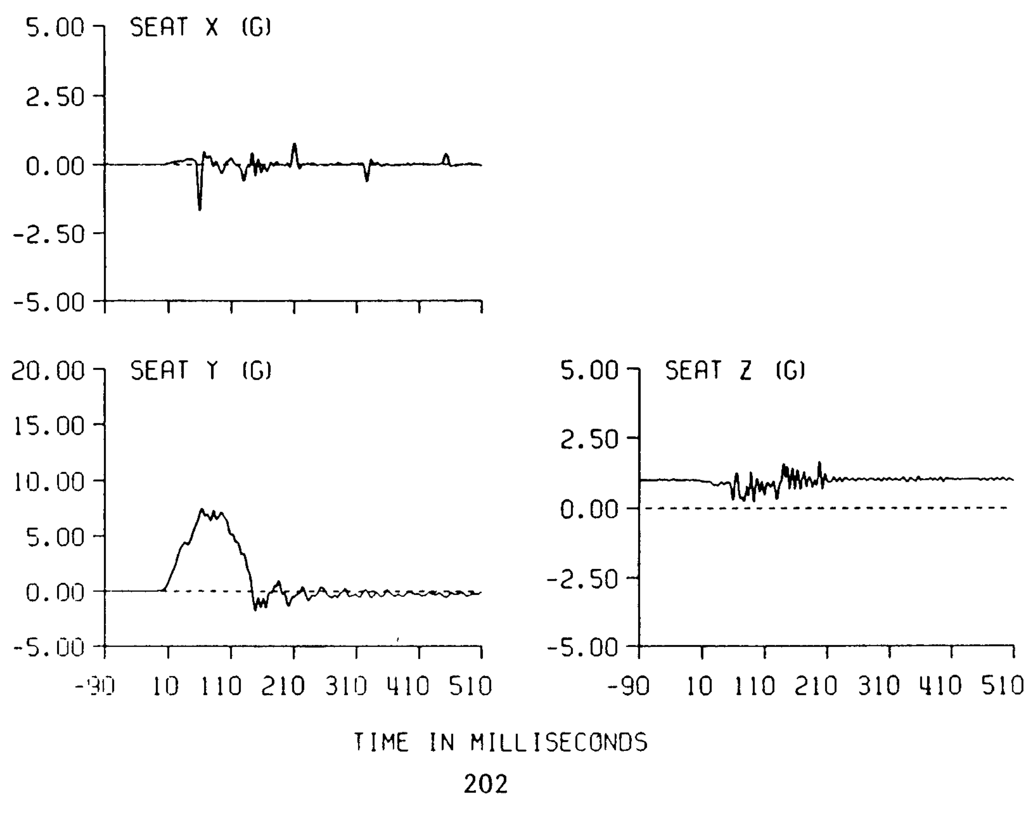
JPATS STUDY TEST: 3372 SUBJ: JPAT-L CELL: E



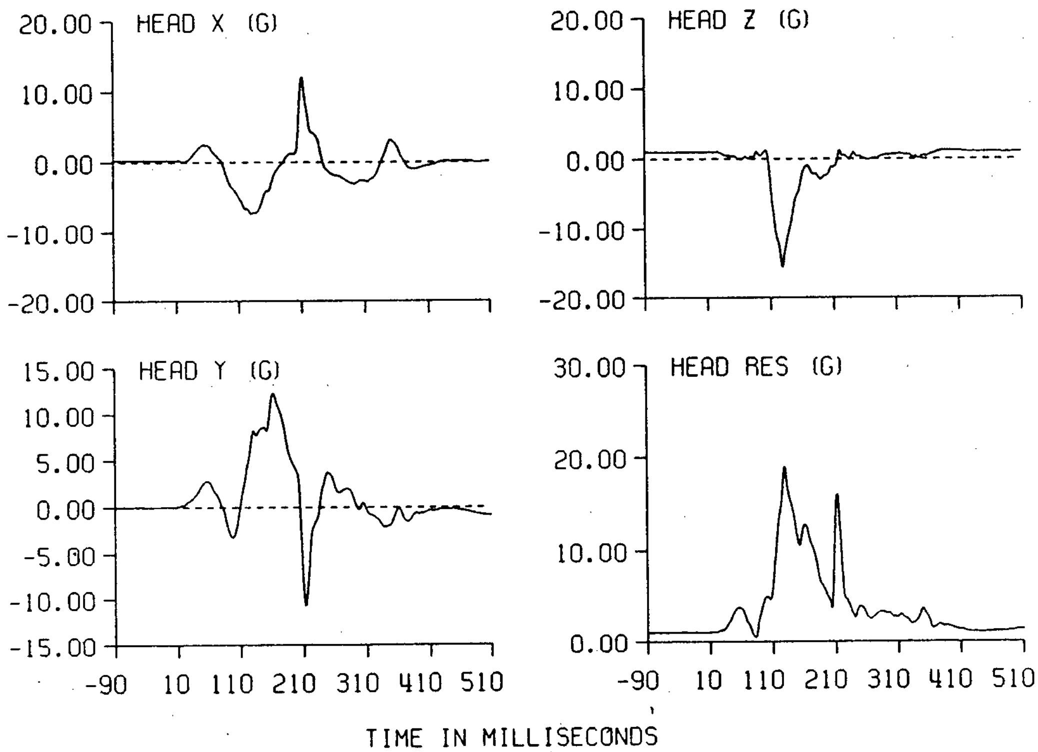
JPATS +GY STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



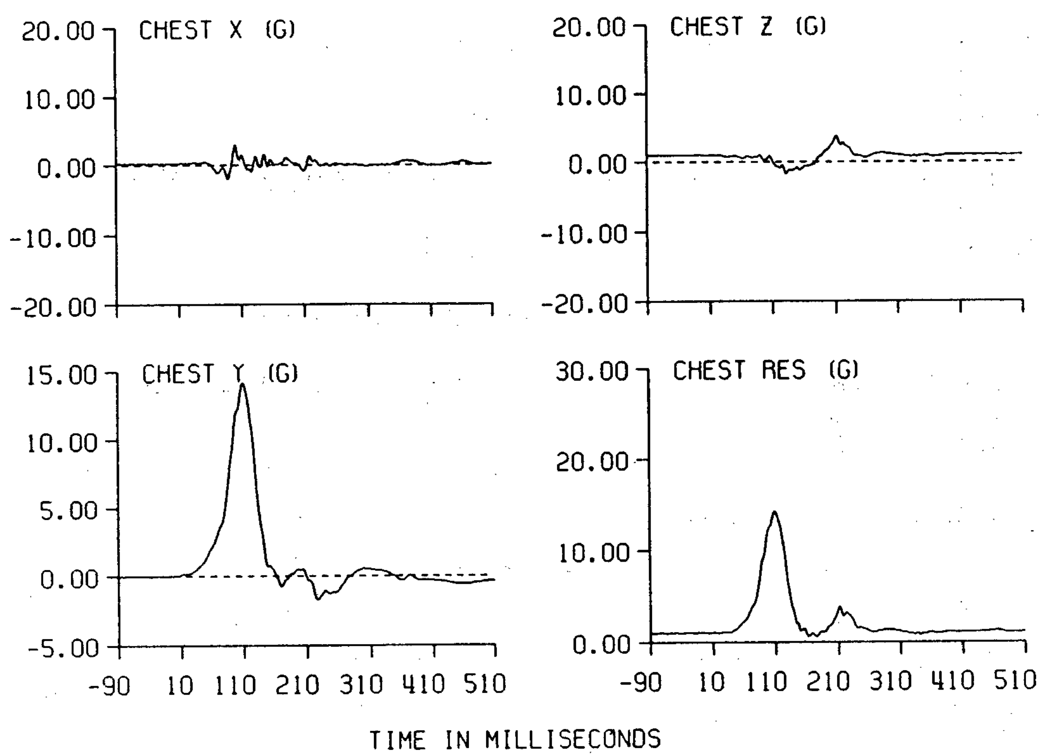
JPATS +GY STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



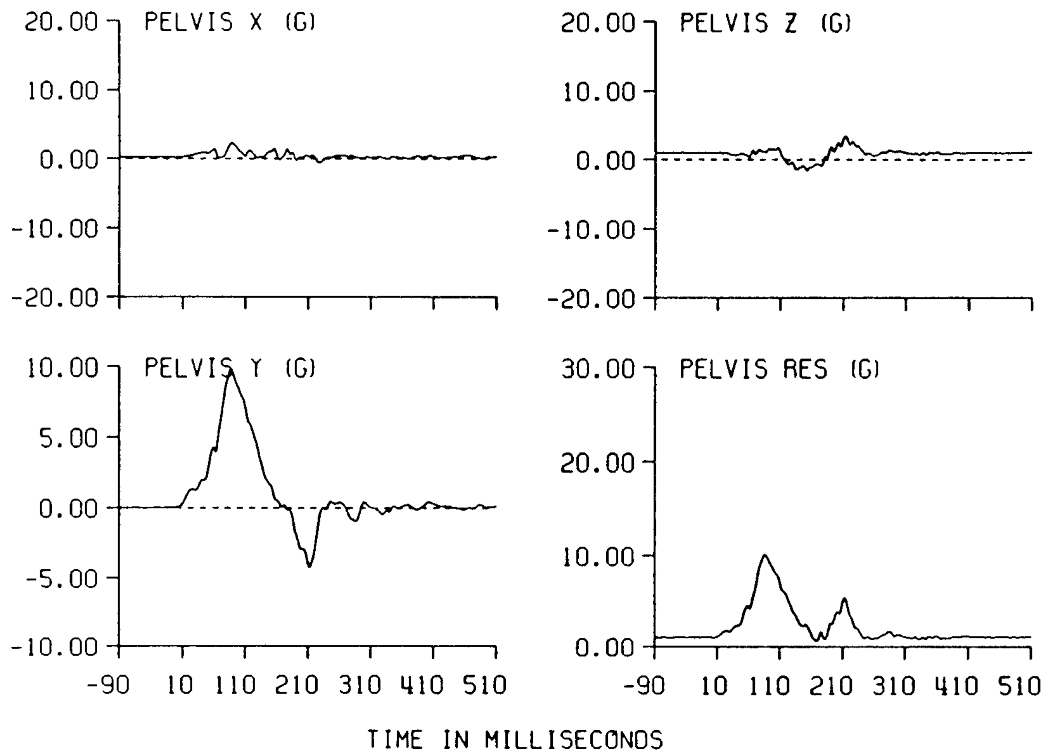
JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



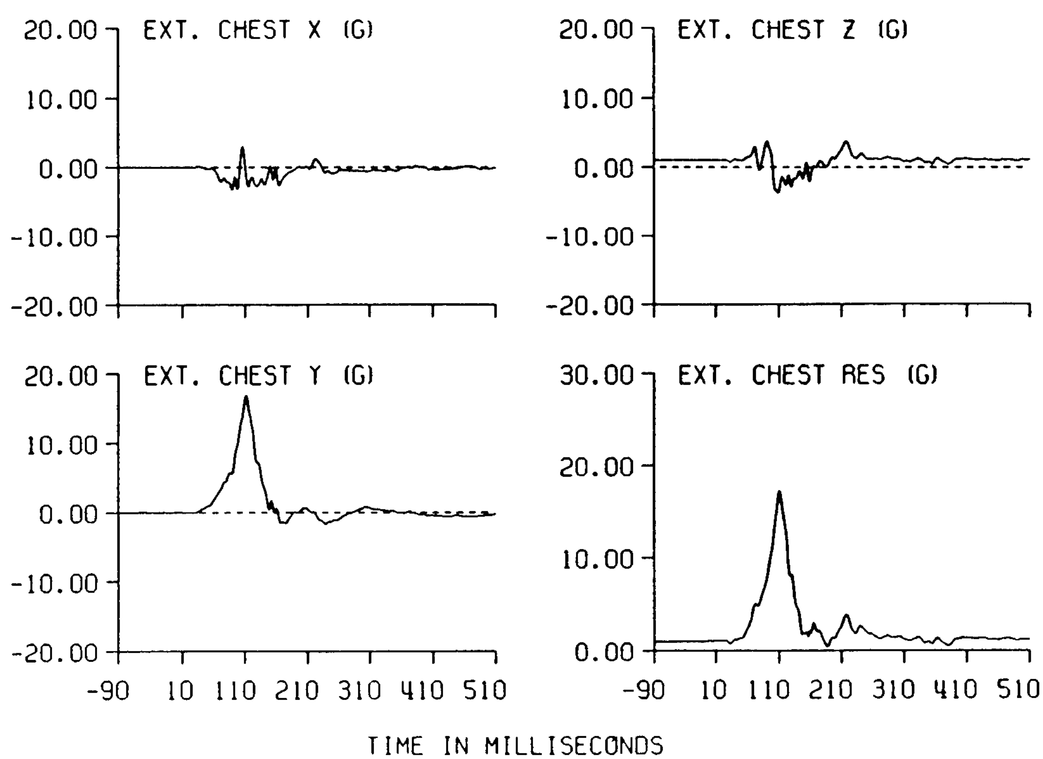
JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



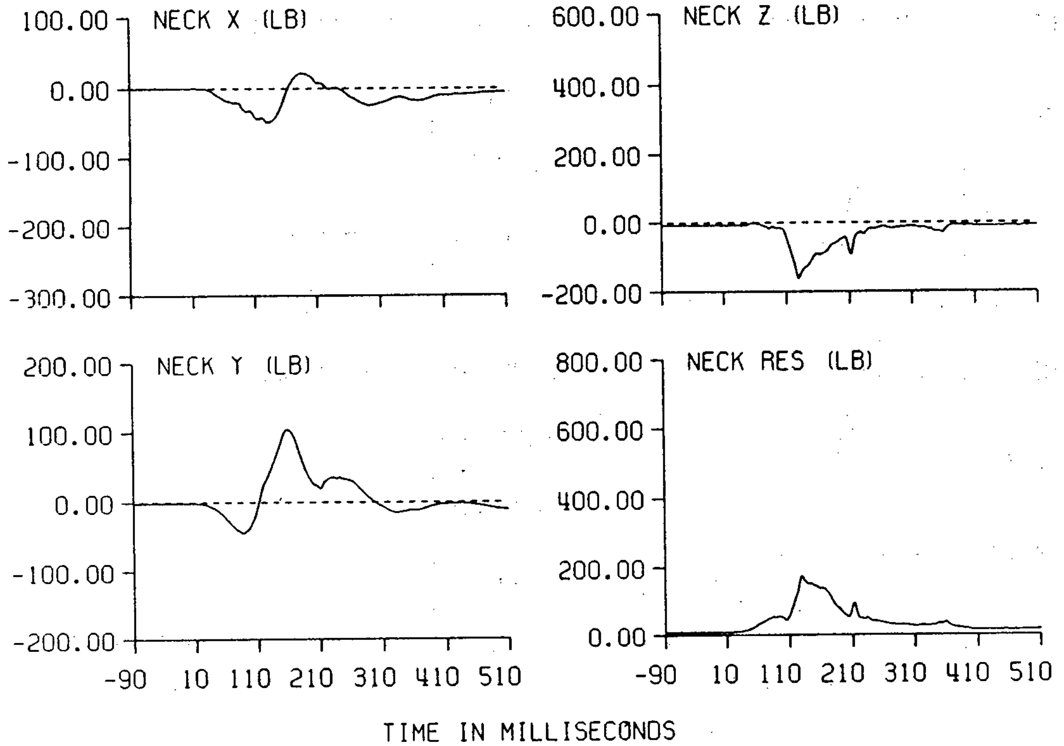
JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



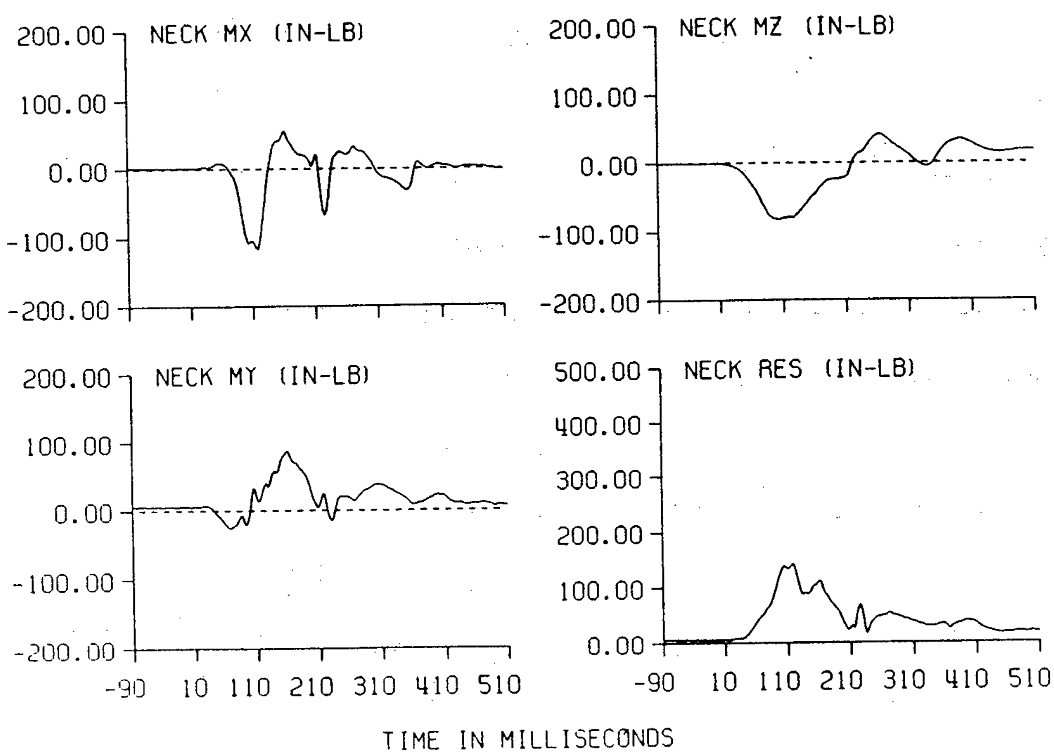
JPATS +GY STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



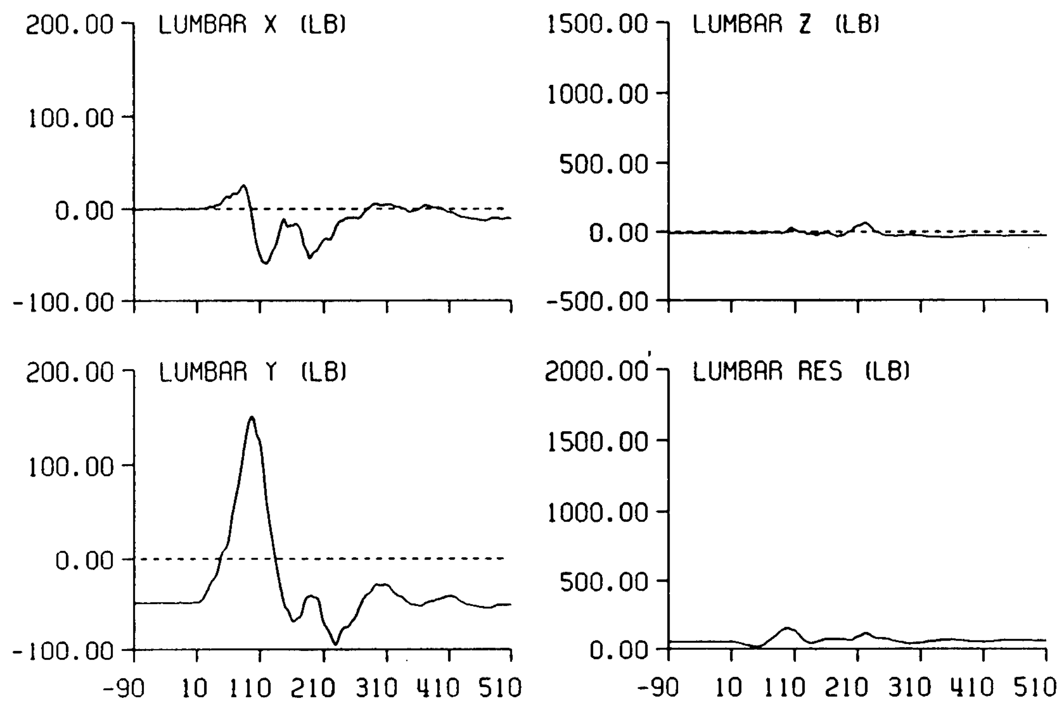
JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F

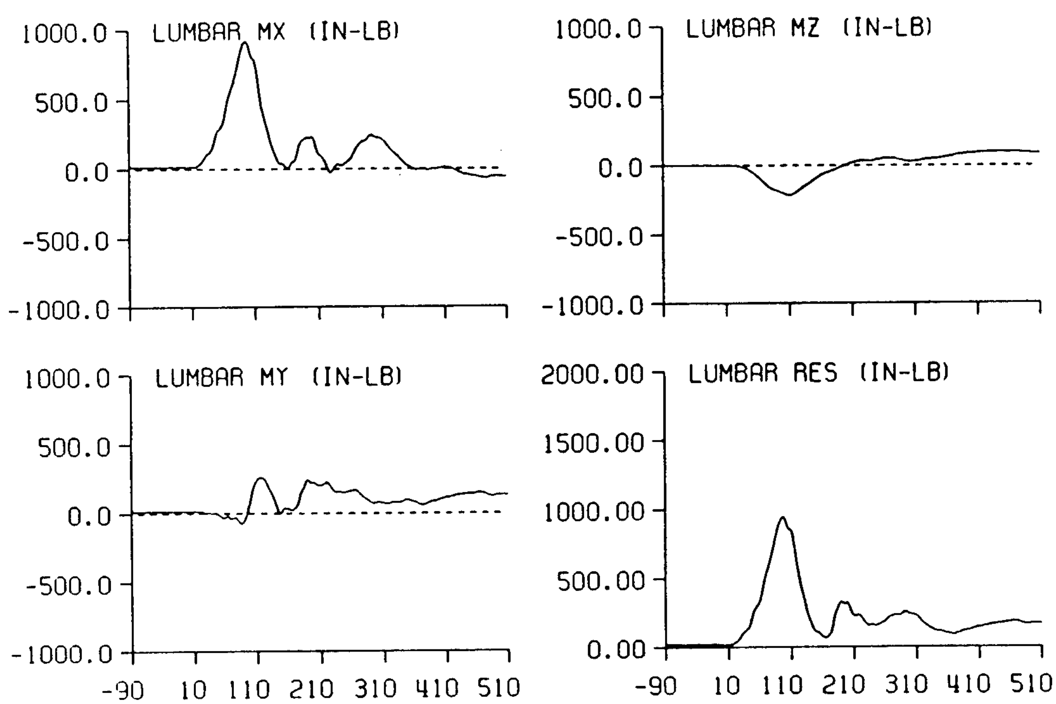


JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F



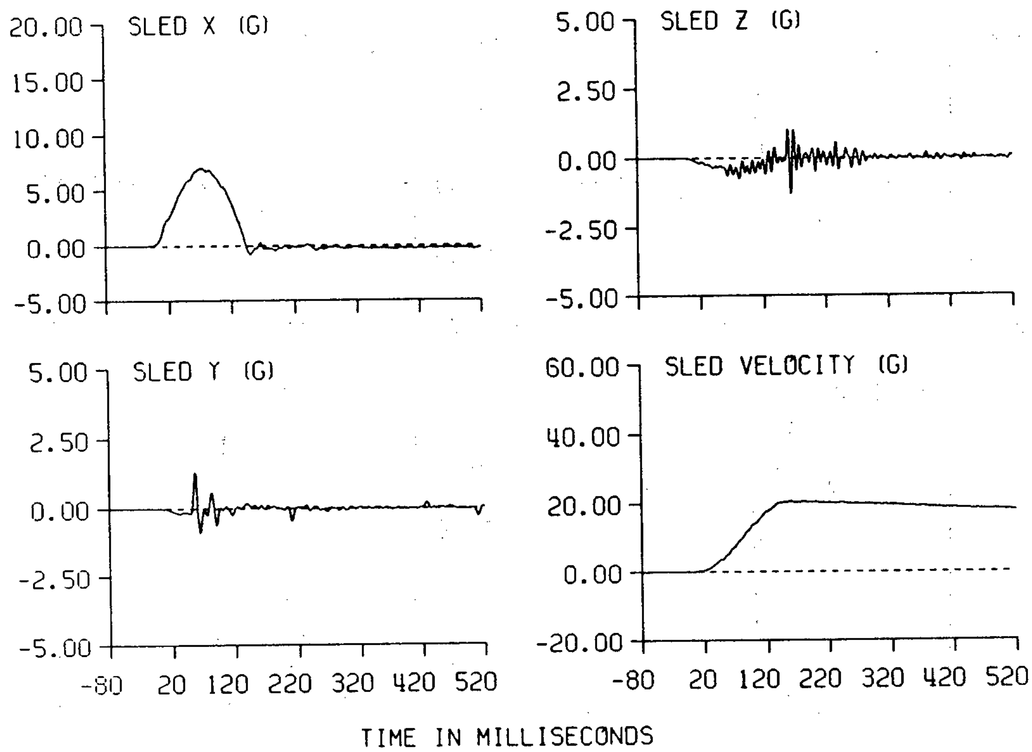
TIME IN MILLISECONDS

JPATS STUDY TEST: 5222 SUBJ: JPAT-S CELL: F

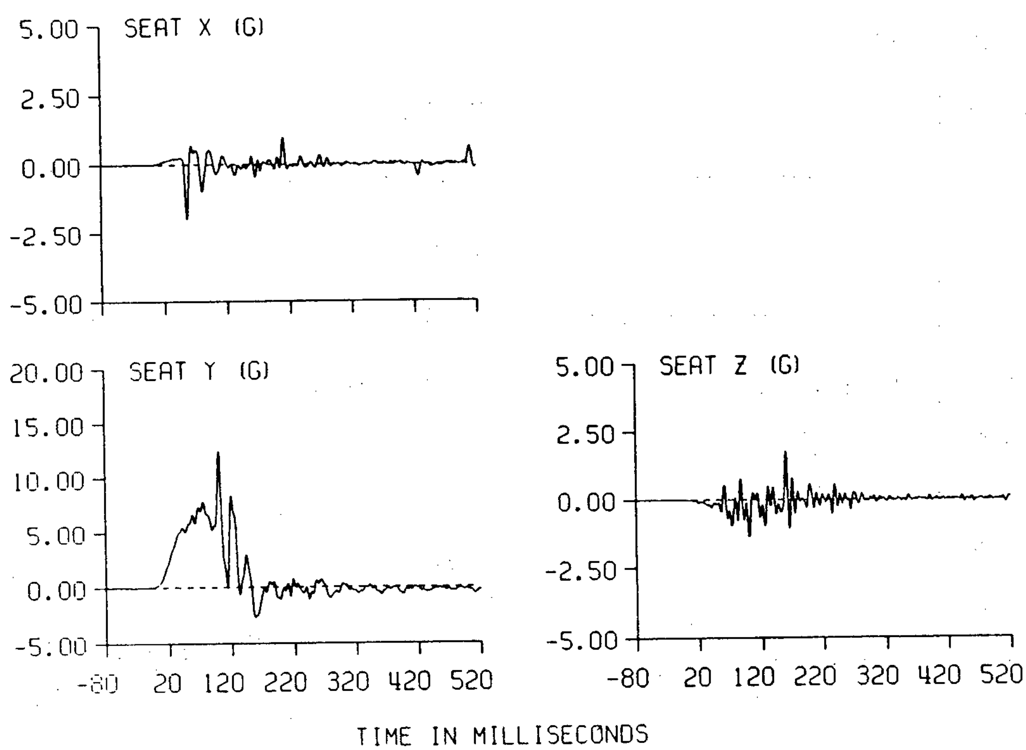


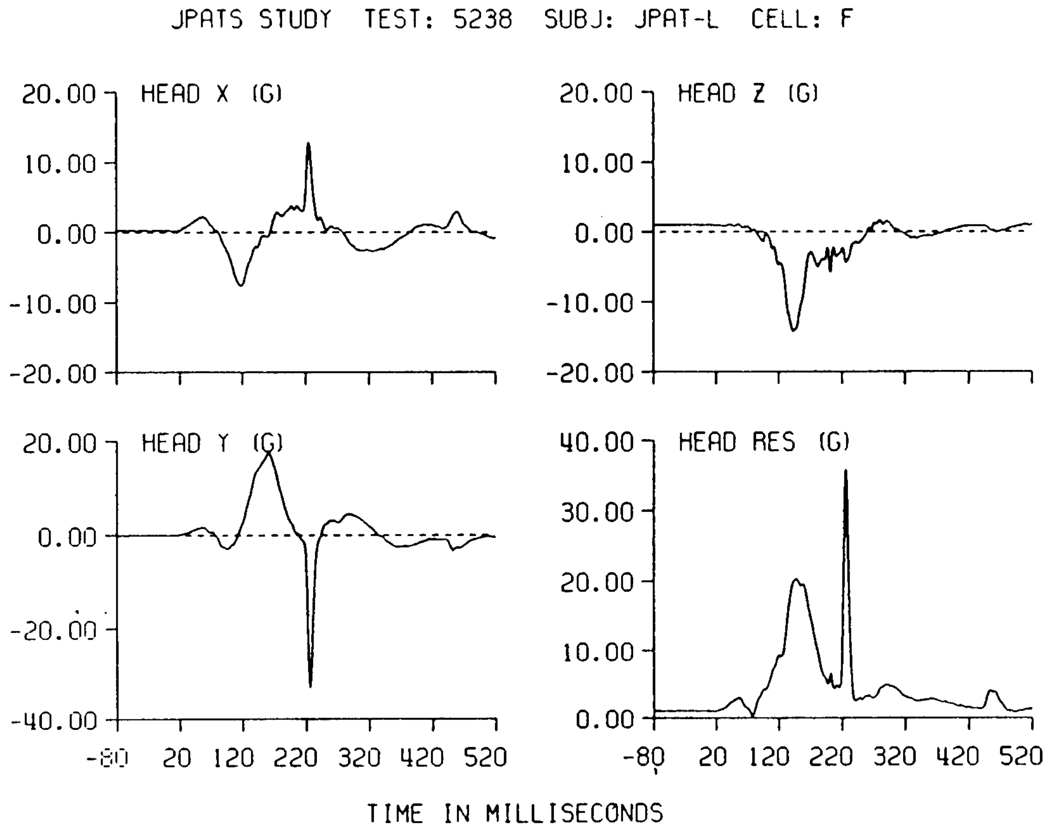
TIME IN MILLISECONDS

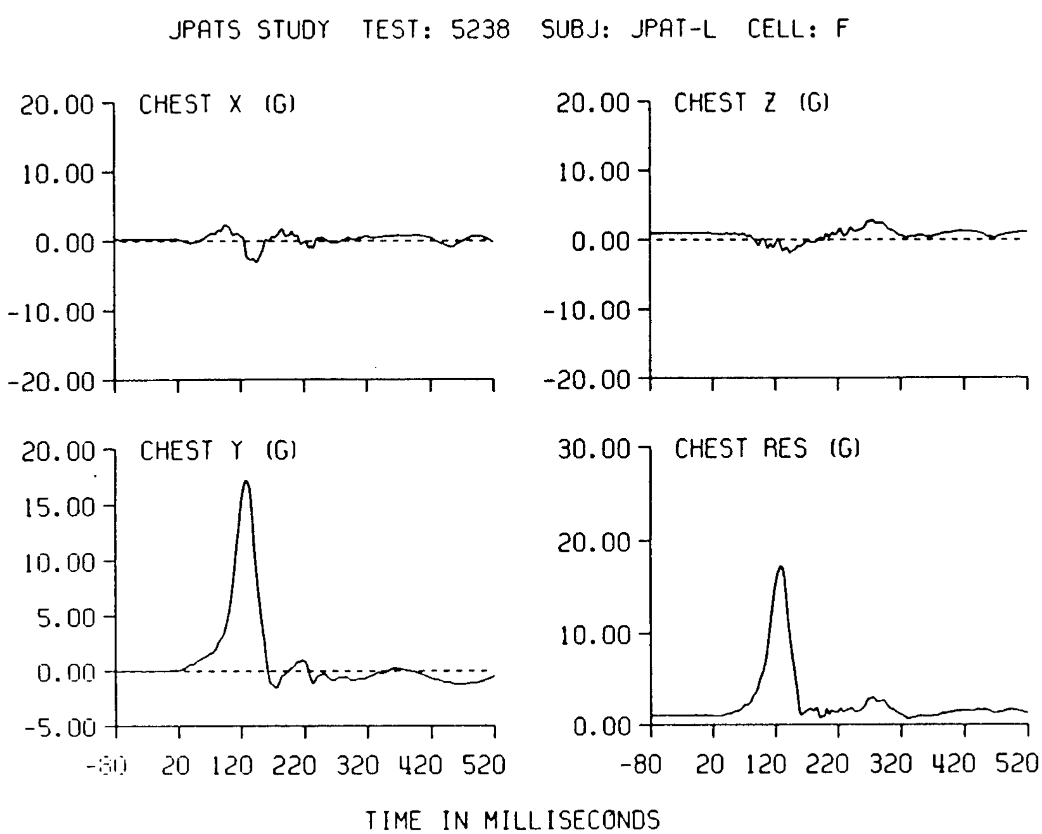
JPATS +GY STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



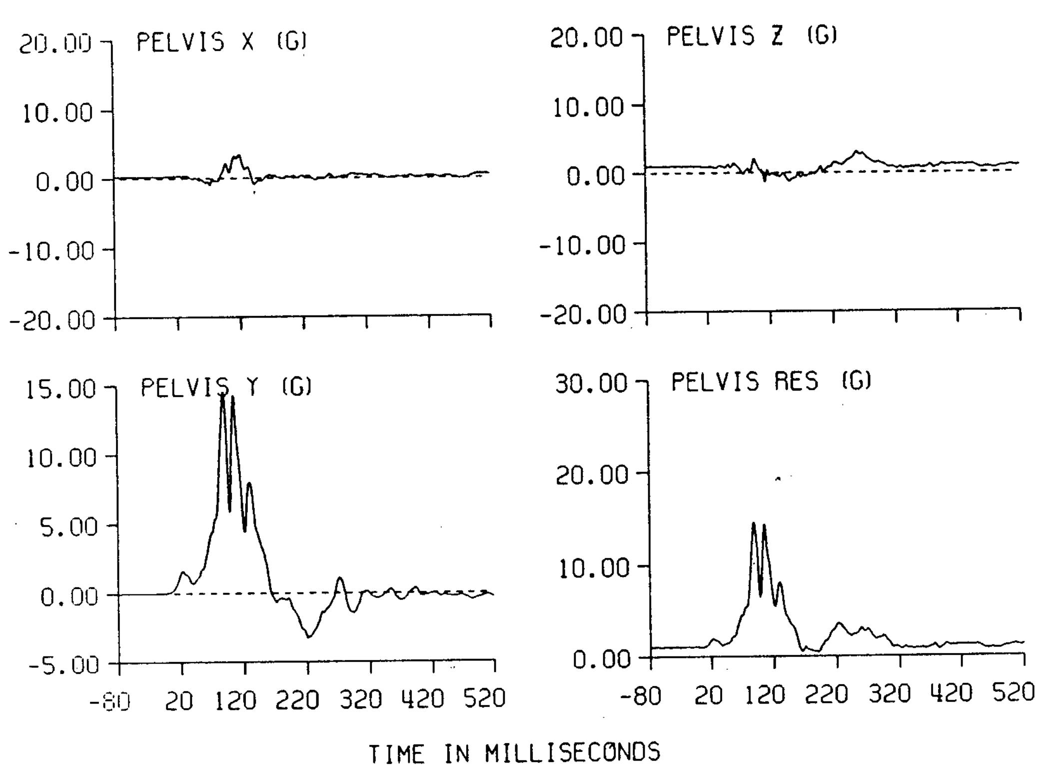
JPATS +GY STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



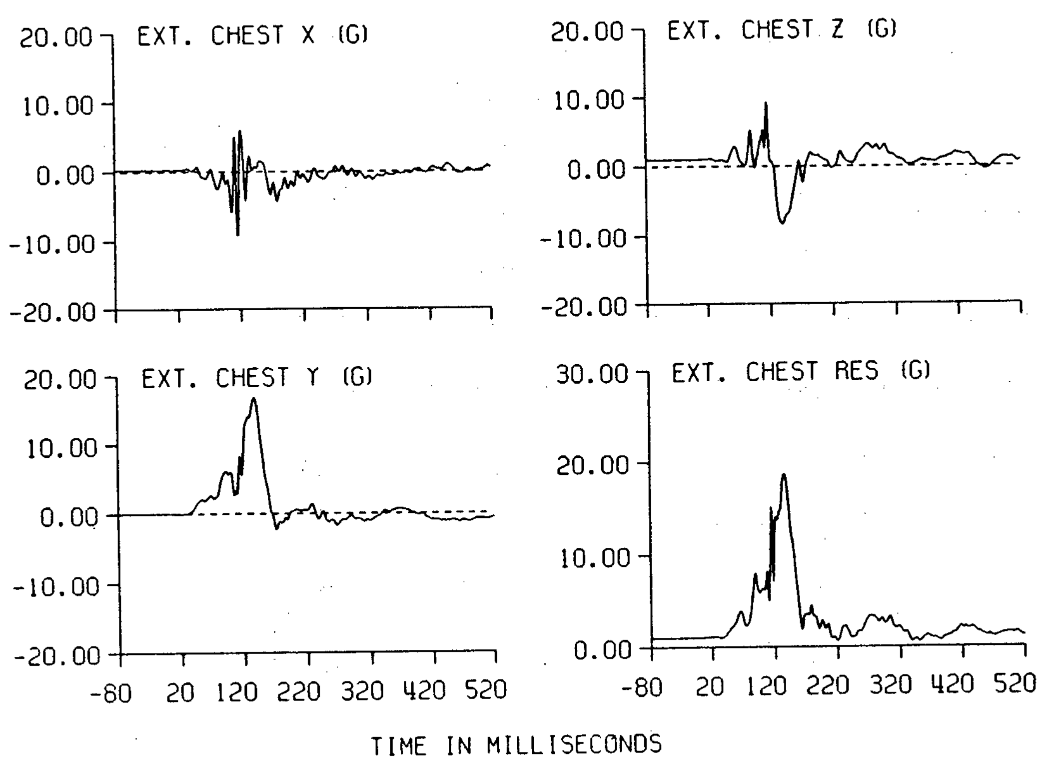

JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F
HEAD X (G)
HEAD Z (G)
HEAD Y (G)
HEAD RES (G)
TIME IN MILLISECONDS

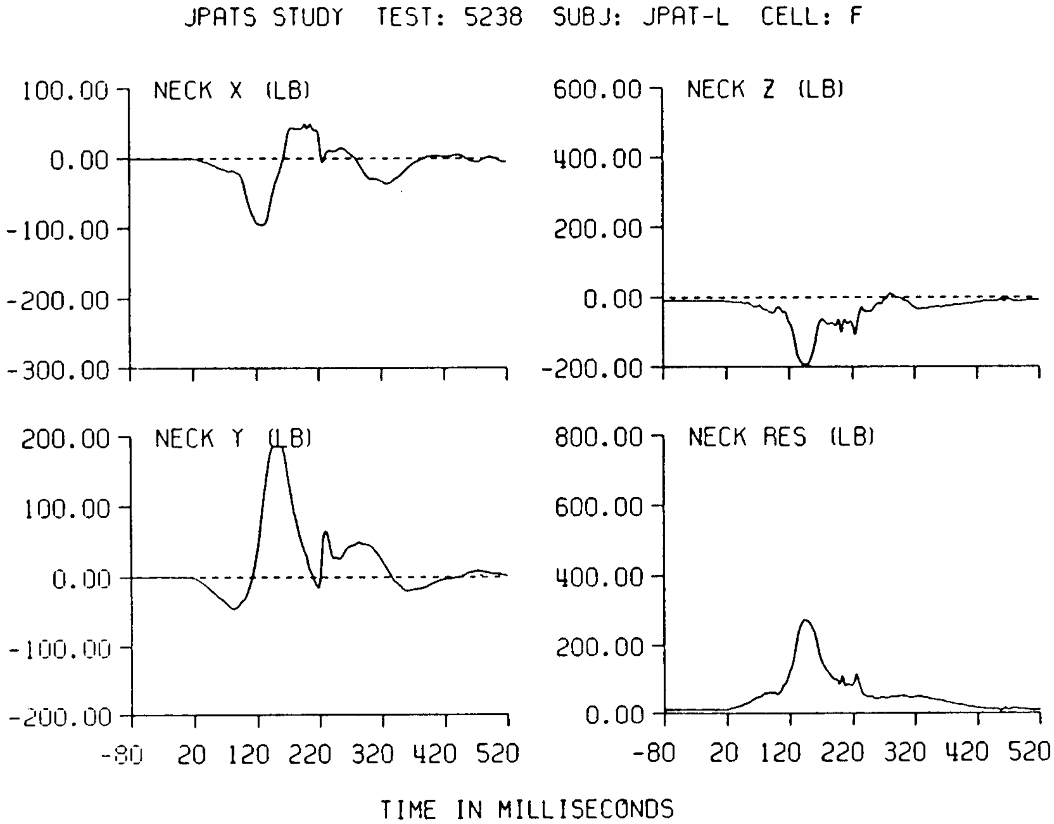

JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F
CHEST X (G)
CHEST Z (G)
CHEST Y (G)
CHEST RES (G)
TIME IN MILLISECONDS

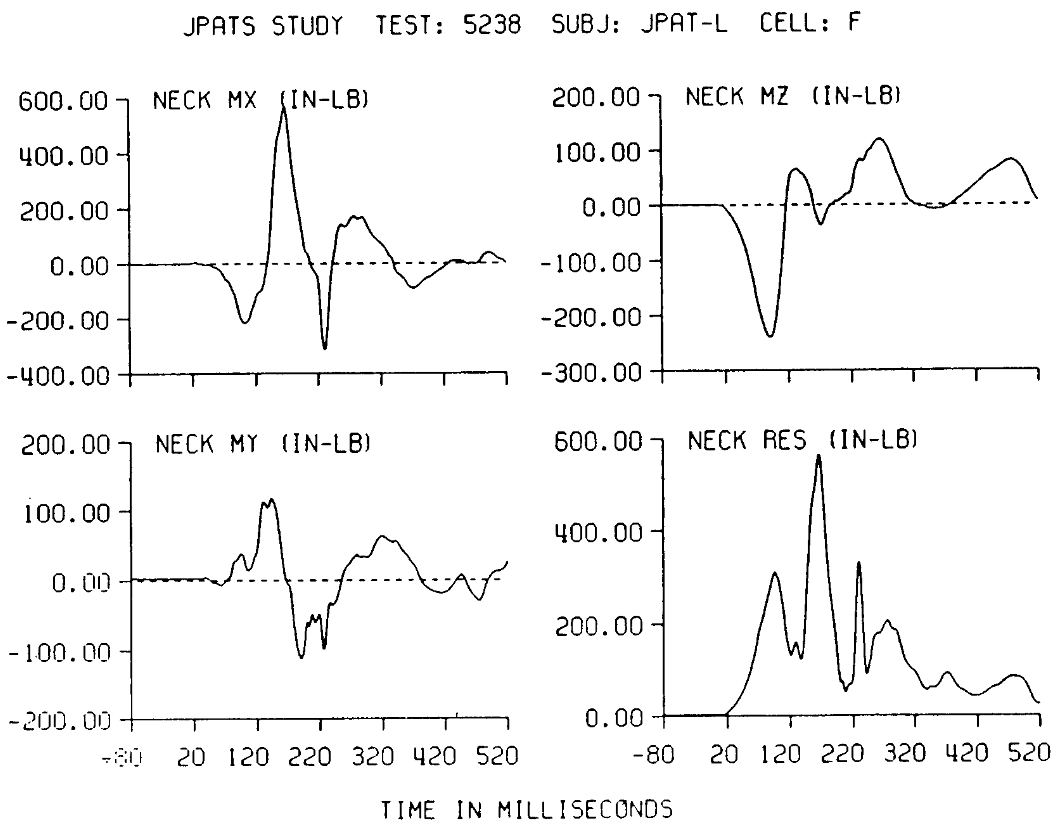
JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



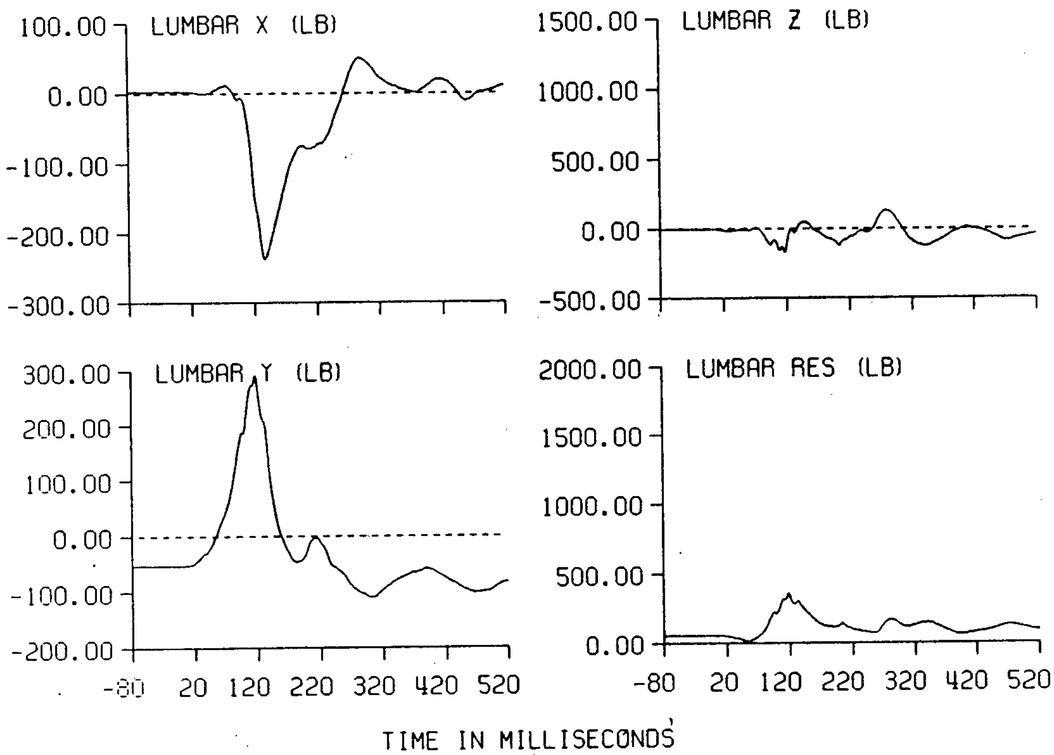
JPATS +GY STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



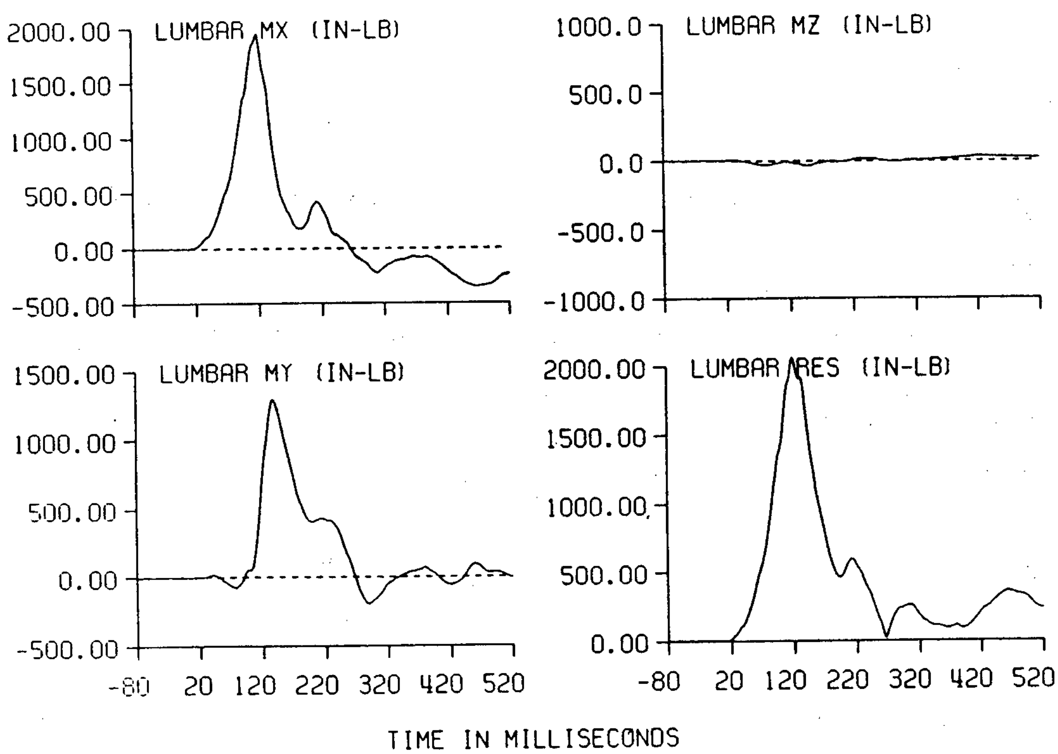

JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F
NECK X (LB)
100.00
0.00
-100.00
-200.00
-300.00
NECK Z (LB)
600.00
400.00
200.00
0.00
-200.00
NECK Y (LB)
200.00
100.00
0.00
-100.00
-200.00
NECK RES (LB)
800.00
600.00
400.00
200.00
0.00
-80 20 120 220 320 420 520
-80 20 120 220 320 420 520
TIME IN MILLISECONDS


JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F
NECK MX (IN-LB)
600.00
400.00
200.00
0.00
-200.00
-400.00
NECK MZ (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
-300.00
NECK MY (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
NECK RES (IN-LB)
600.00
400.00
200.00
0.00
-80 20 120 220 320 420 520
-80 20 120 220 320 420 520
TIME IN MILLISECONDS

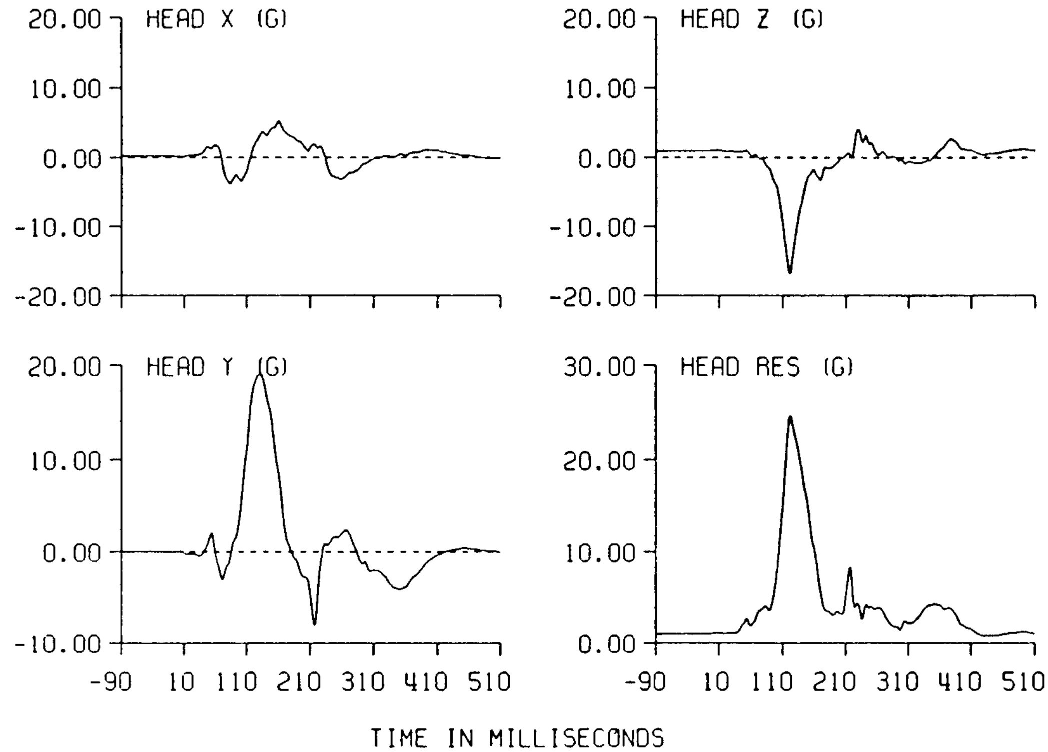
JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



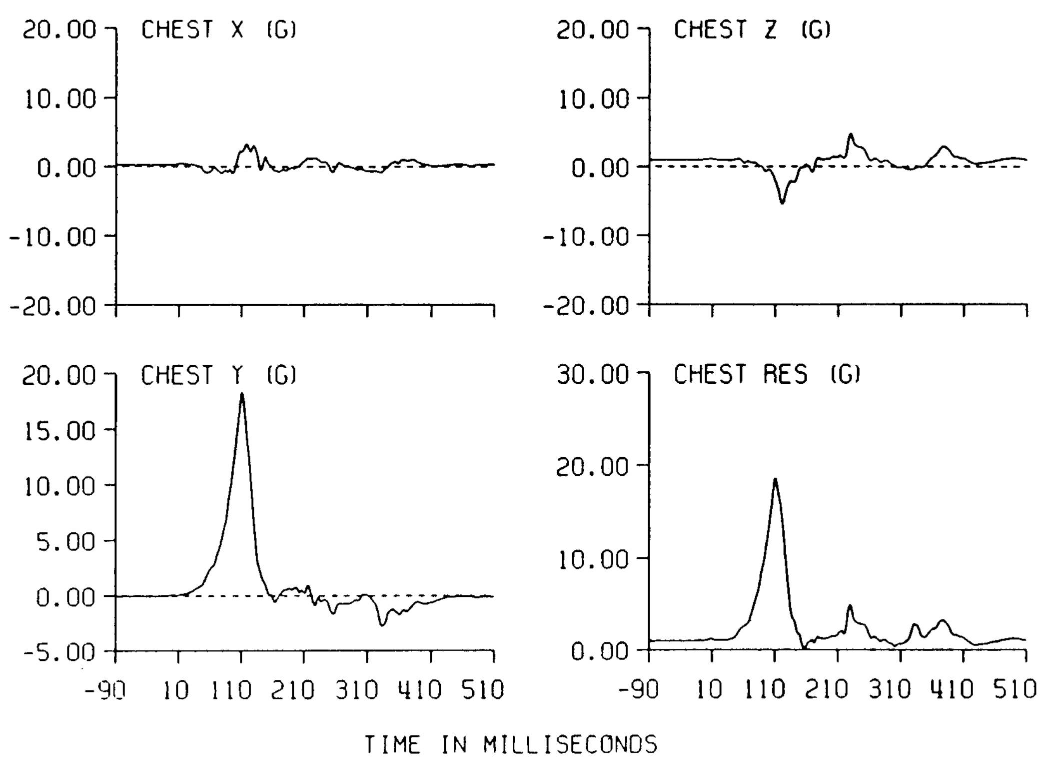
JPATS STUDY TEST: 5238 SUBJ: JPAT-L CELL: F



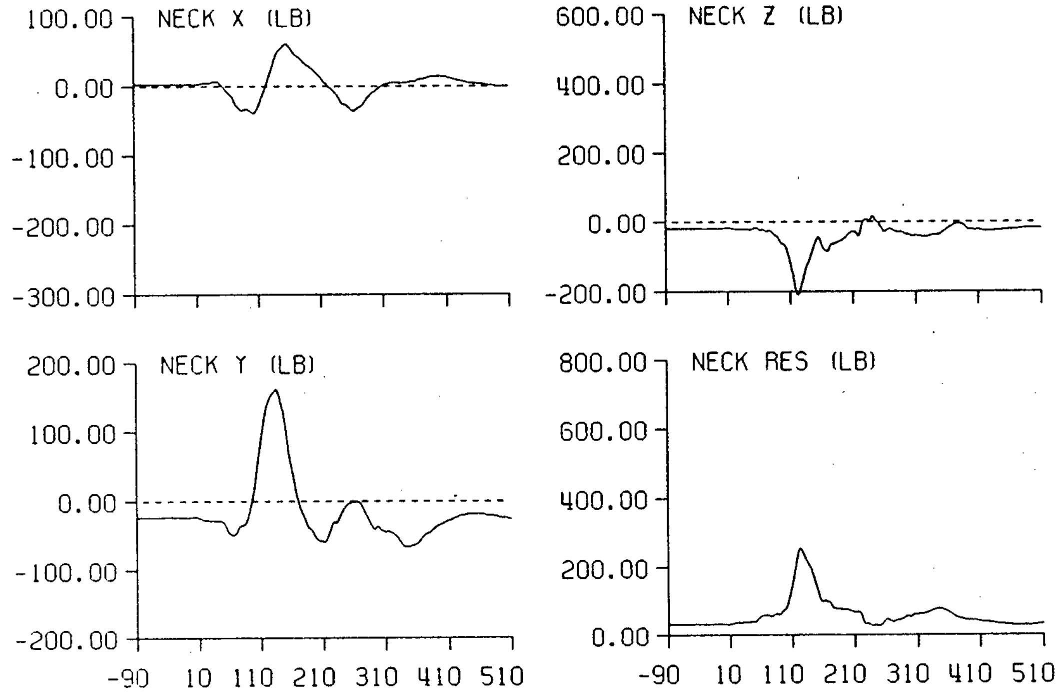
JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F



JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F

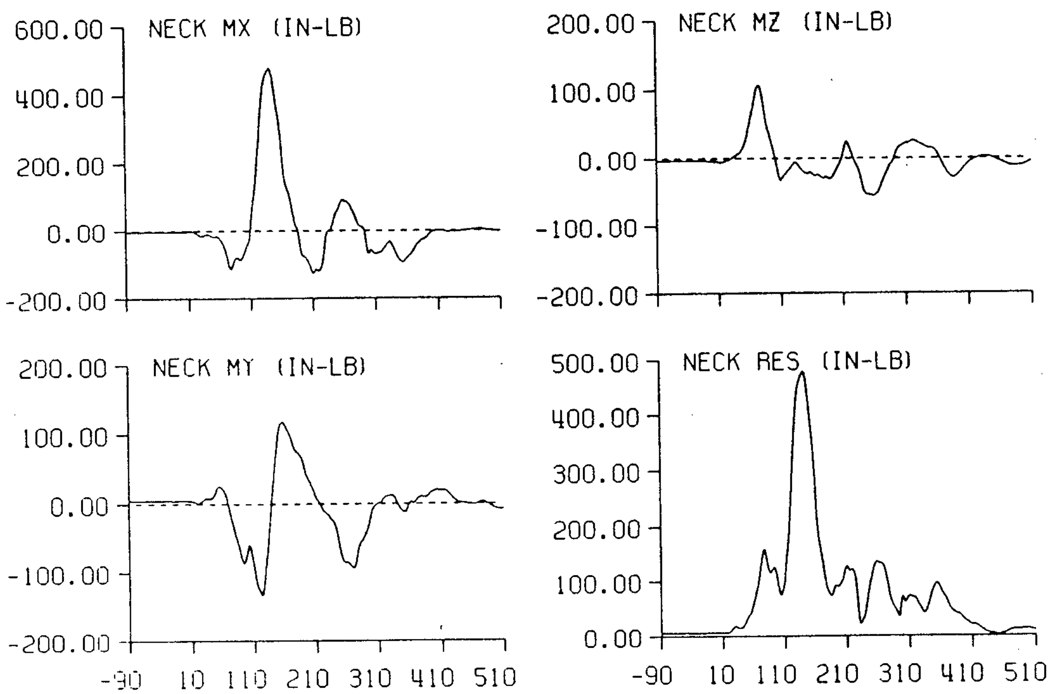


JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F



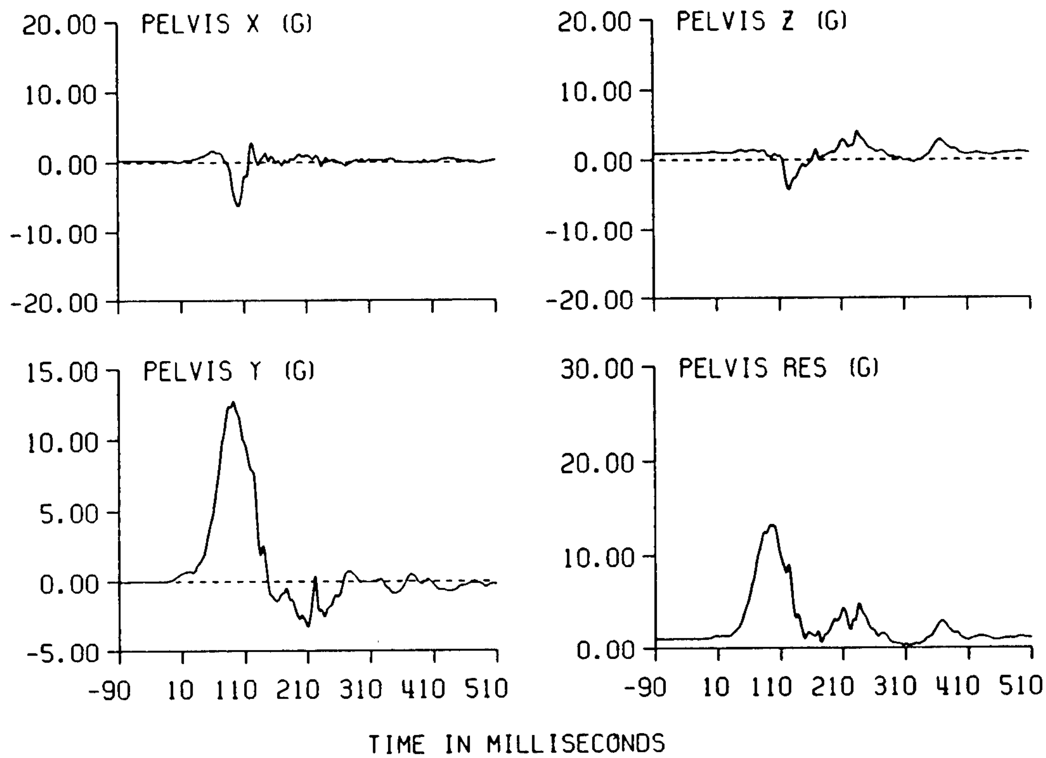
TIME IN MILLISECONDS

JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F

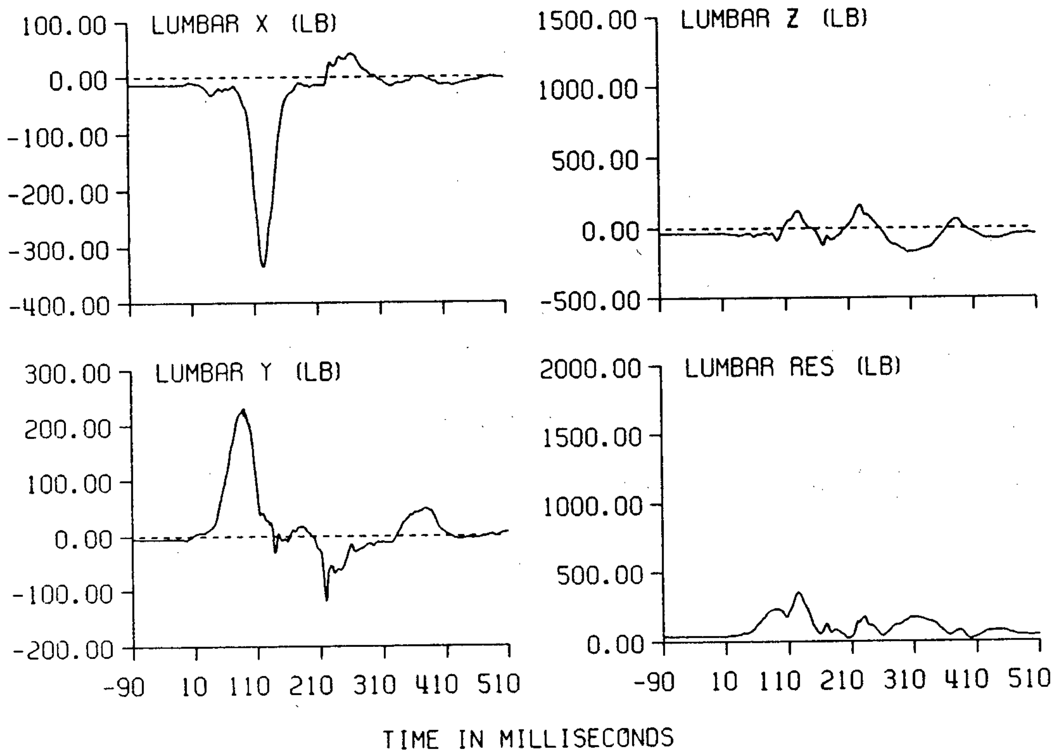


TIME IN MILLISECONDS

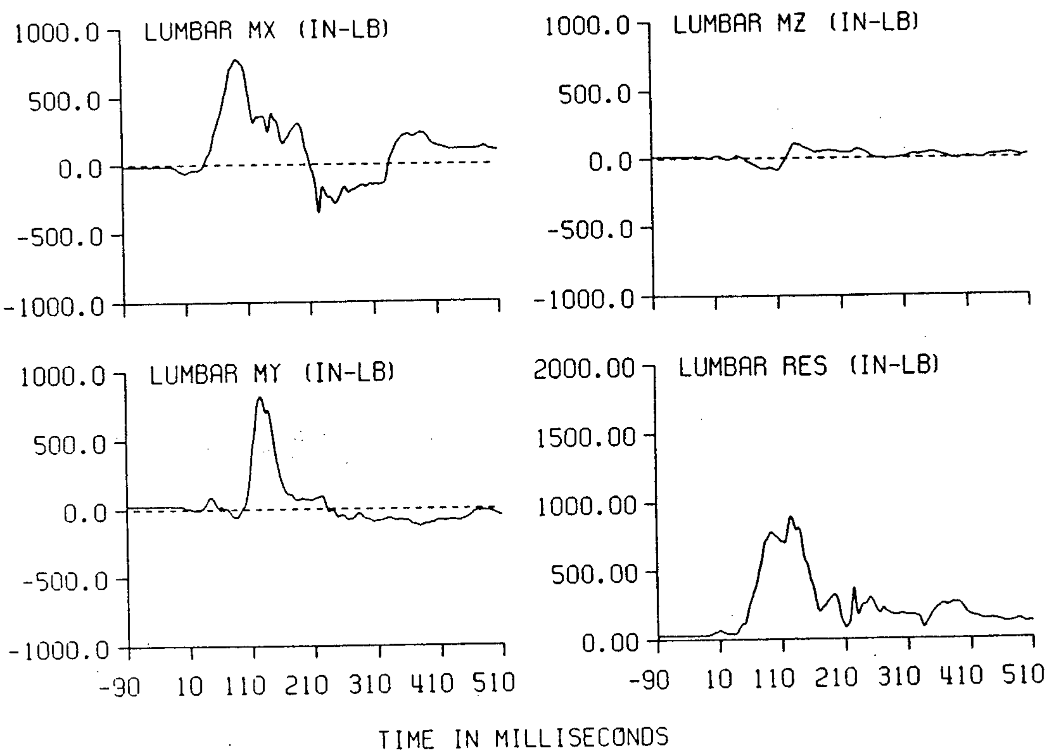
JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F



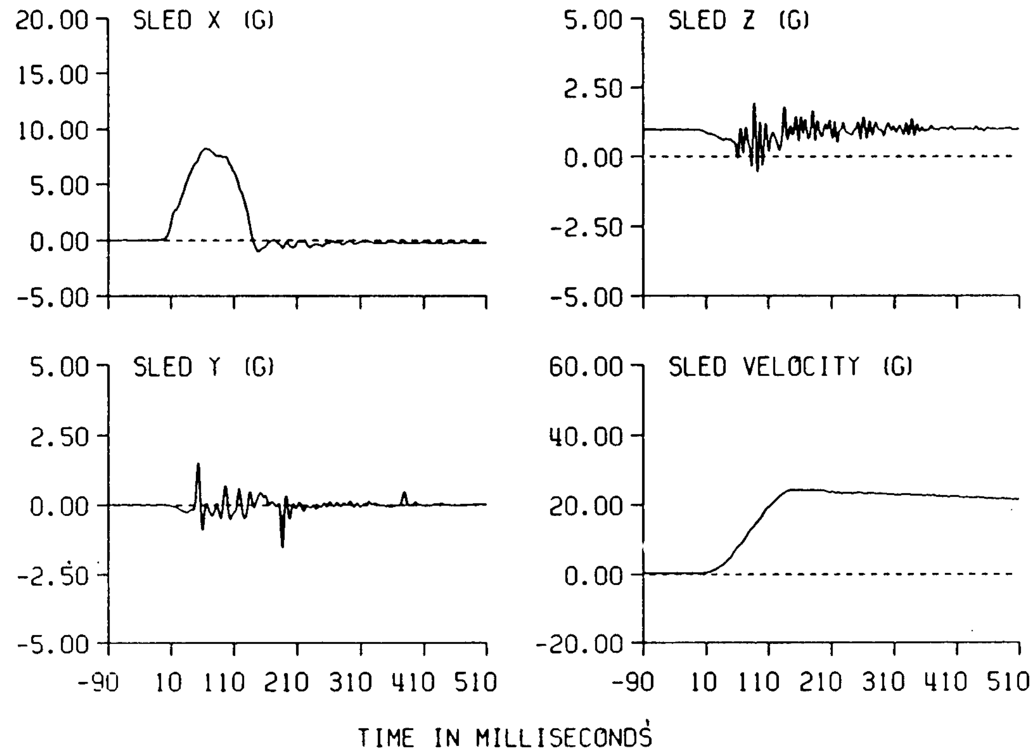
JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F



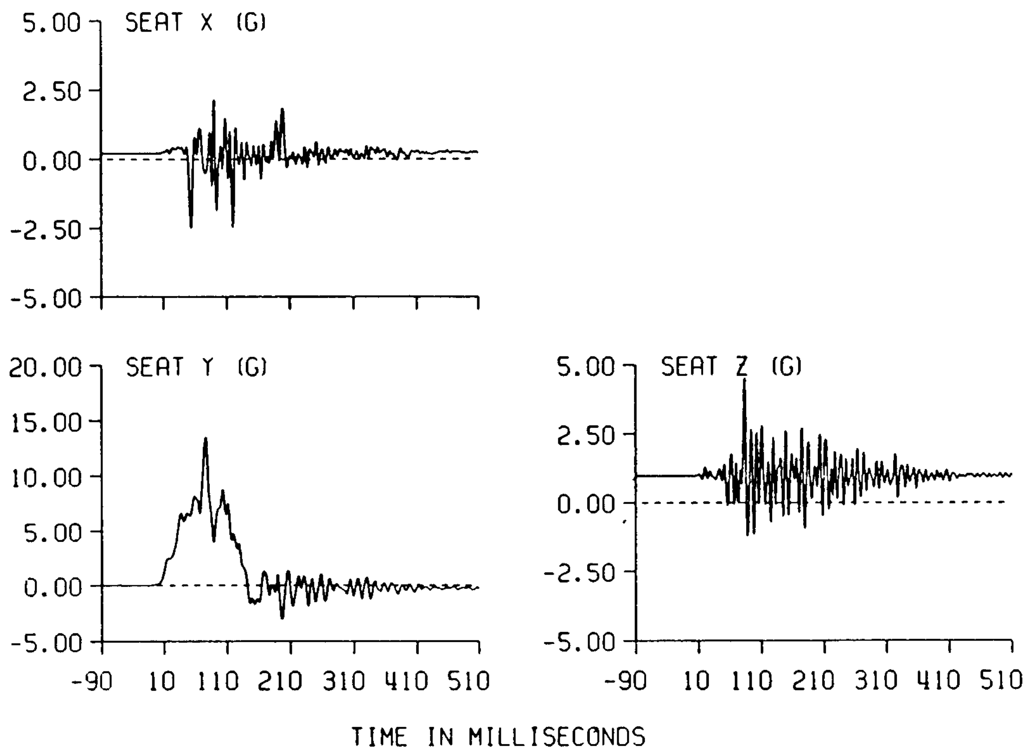
JPATS STUDY TEST: 5228 SUBJ: ADAM-L CELL: F



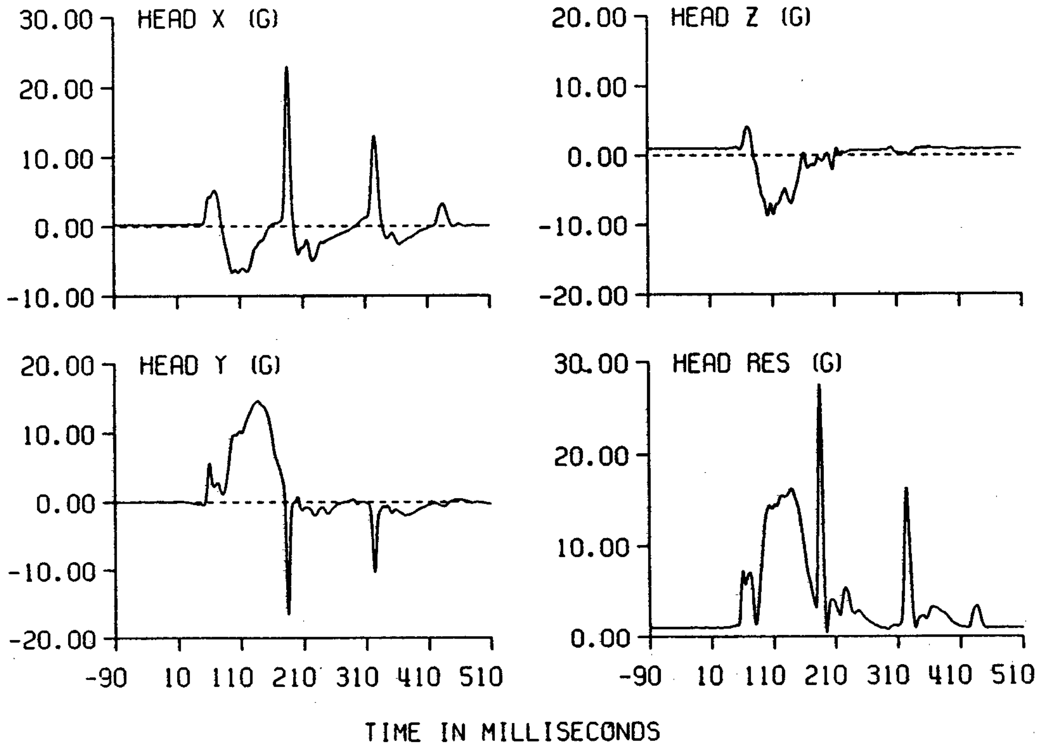
JPATS +GY STUDY TEST: 5267 SUBJ: ADAM-L CELL: G



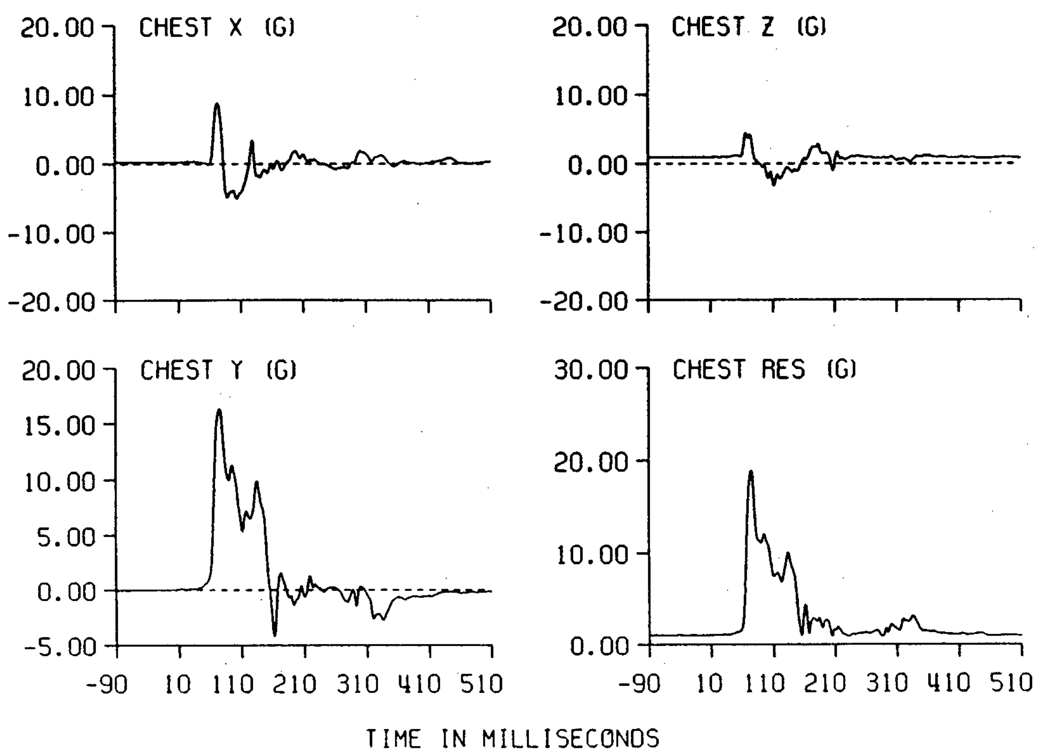
JPATS +GY STUDY TEST: 5267 SUBJ: ADAM-L CELL: G

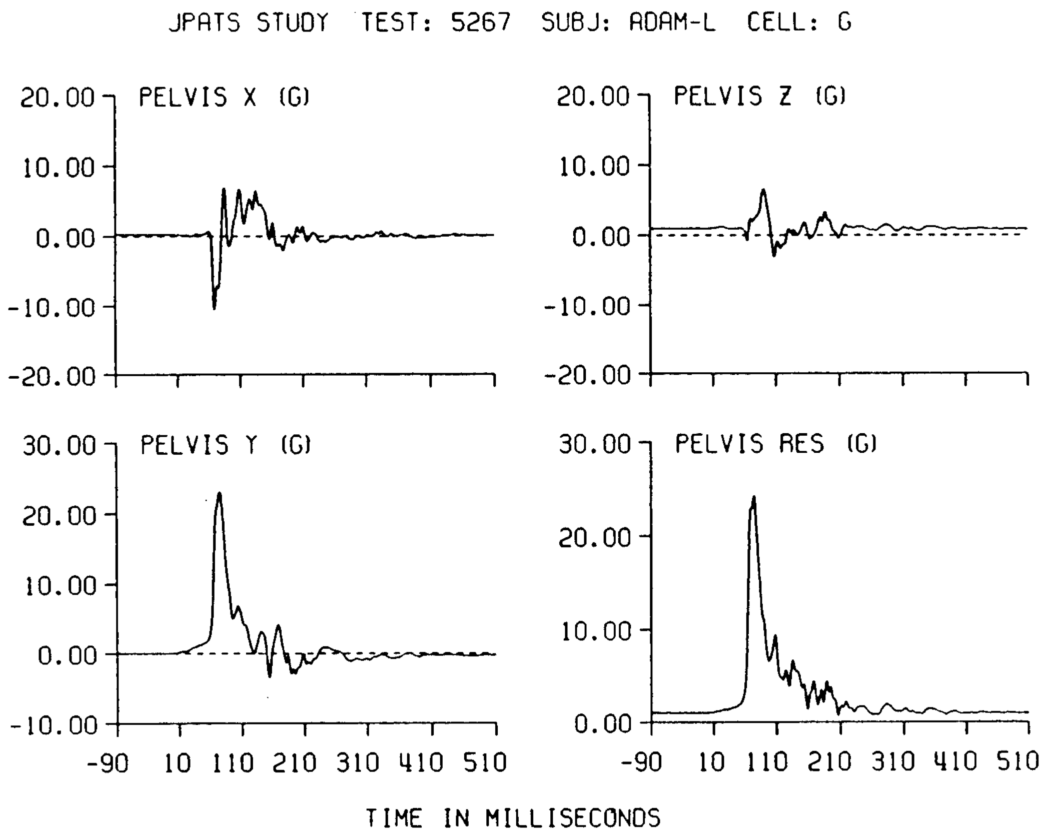


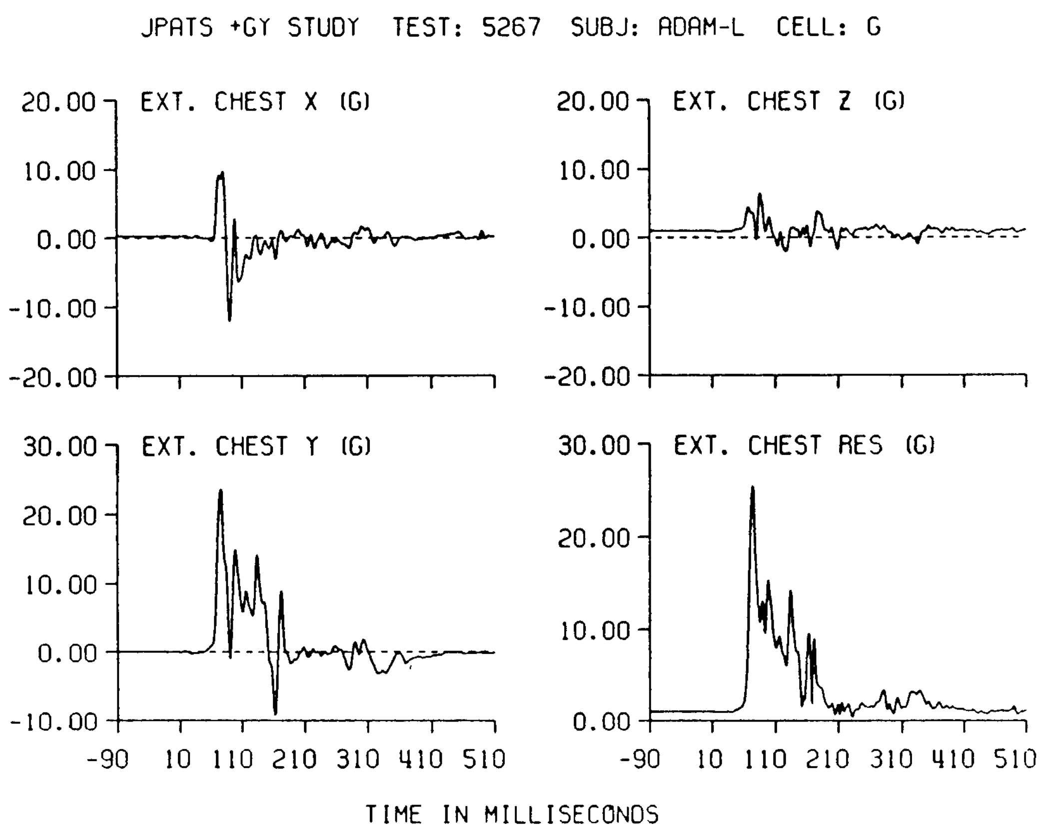
JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G

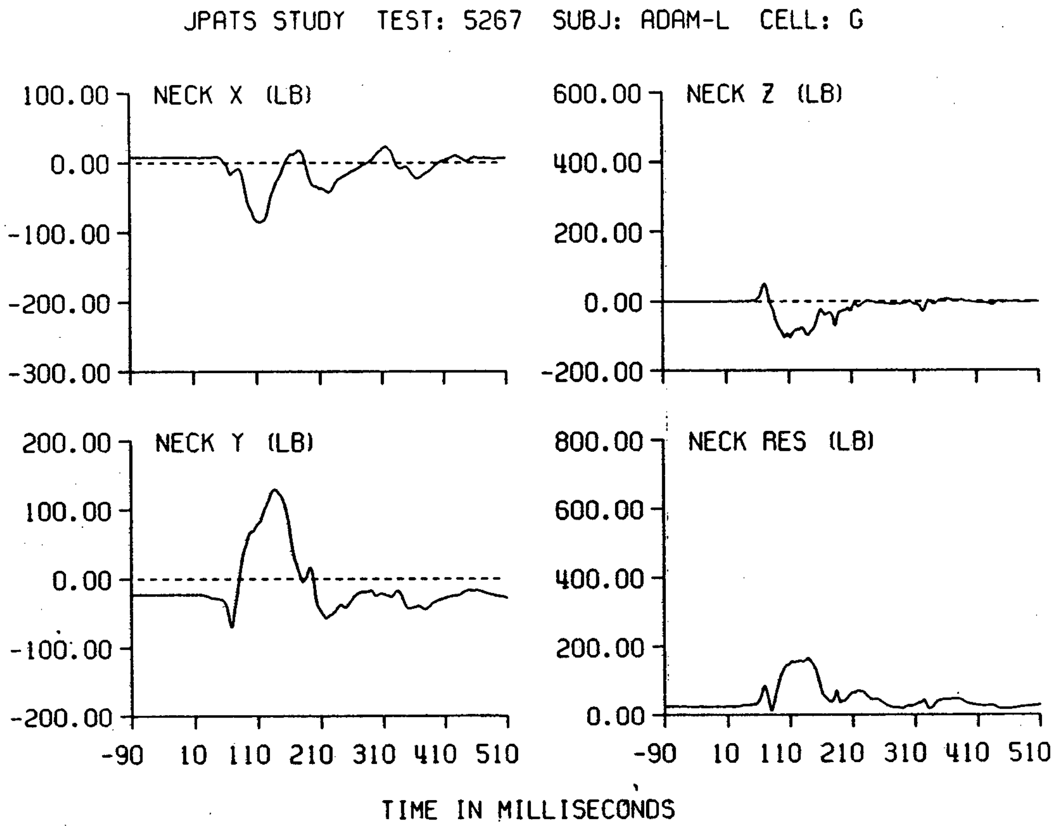


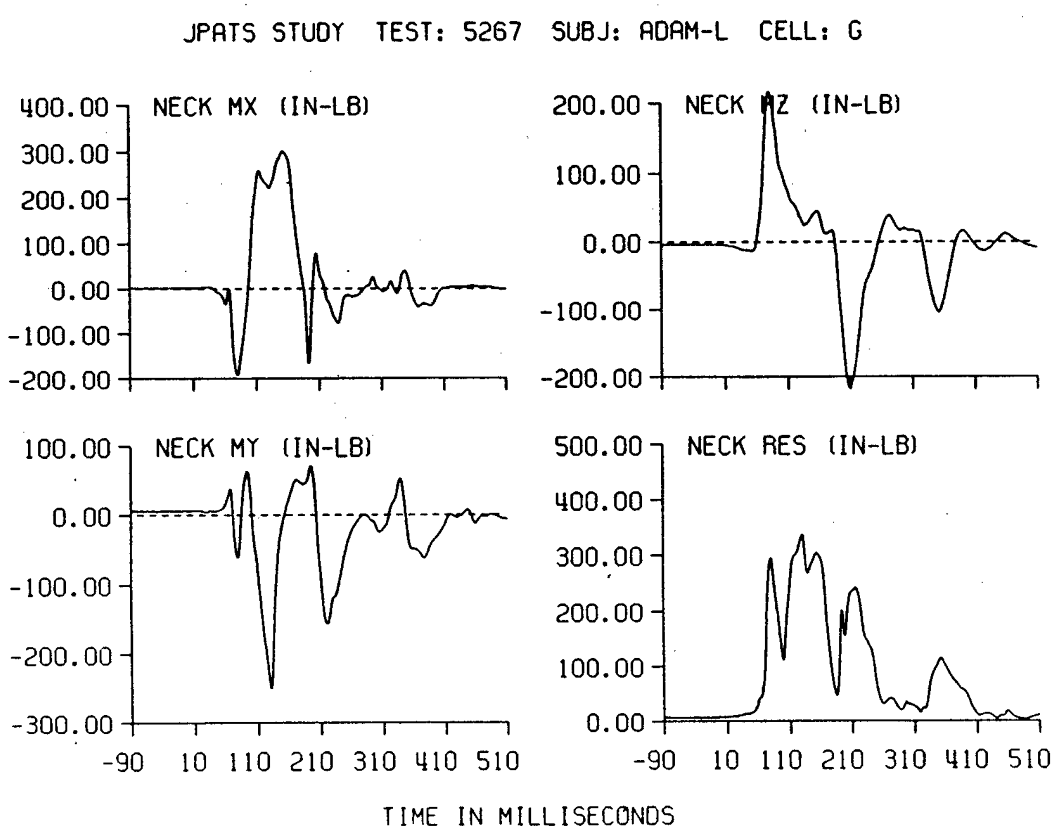
JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G



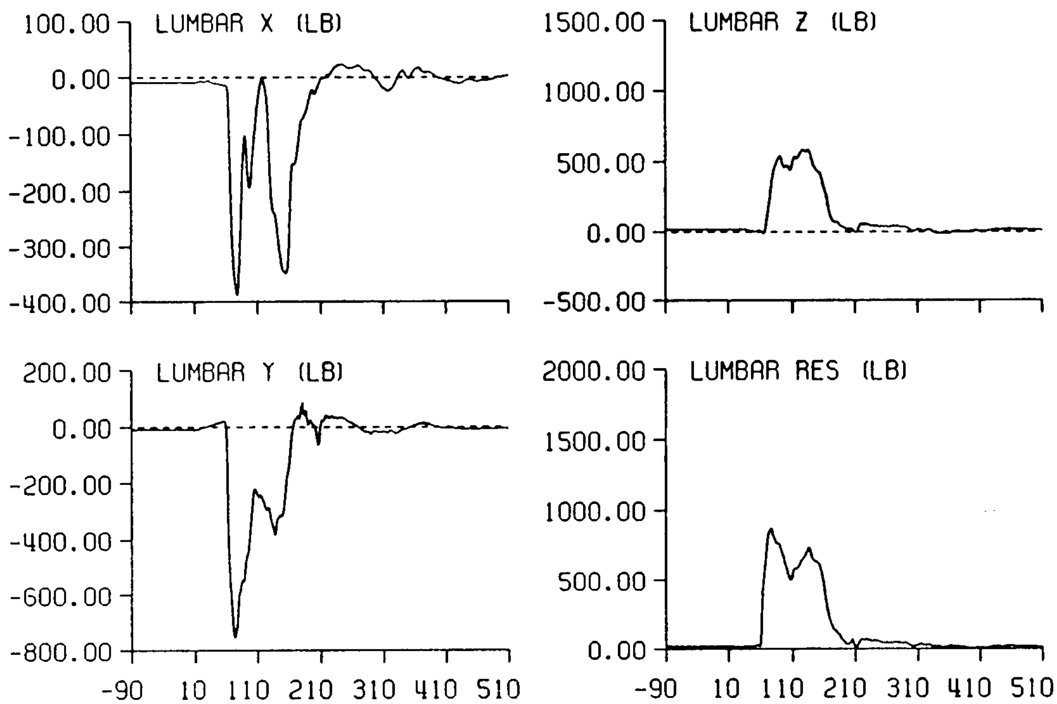

JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G
PELVIS X (G)
PELVIS Z (G)
PELVIS Y (G)
PELVIS RES (G)
20.00
10.00
0.00
-10.00
-20.00
30.00
-90
10
110
210
310
410
510
TIME IN MILLISECONDS


JPATS +GY STUDY TEST: 5267 SUBJ: ADAM-L CELL: G
EXT. CHEST X (G)
EXT. CHEST Z (G)
EXT. CHEST Y (G)
EXT. CHEST RES (G)
20.00
10.00
0.00
-10.00
-20.00
30.00
-90
10
110
210
310
410
510
TIME IN MILLISECONDS


JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-90 10 110 210 310 410 510
TIME IN MILLISECONDS

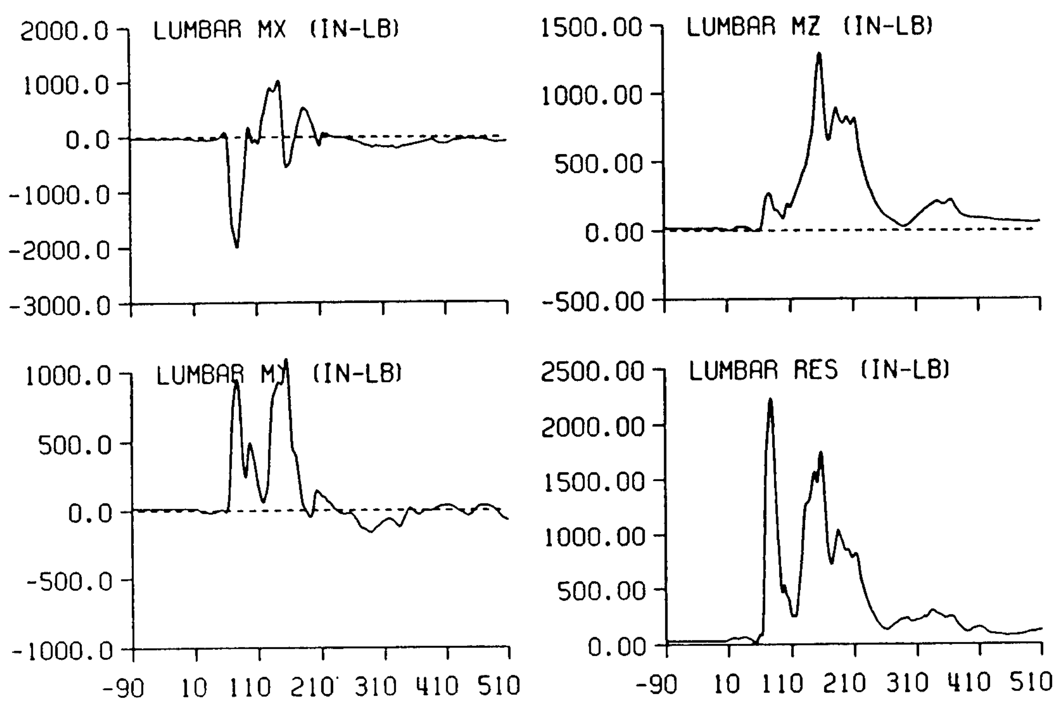

JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
-300.00
500.00
-90 10 110 210 310 410 510
TIME IN MILLISECONDS

JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G



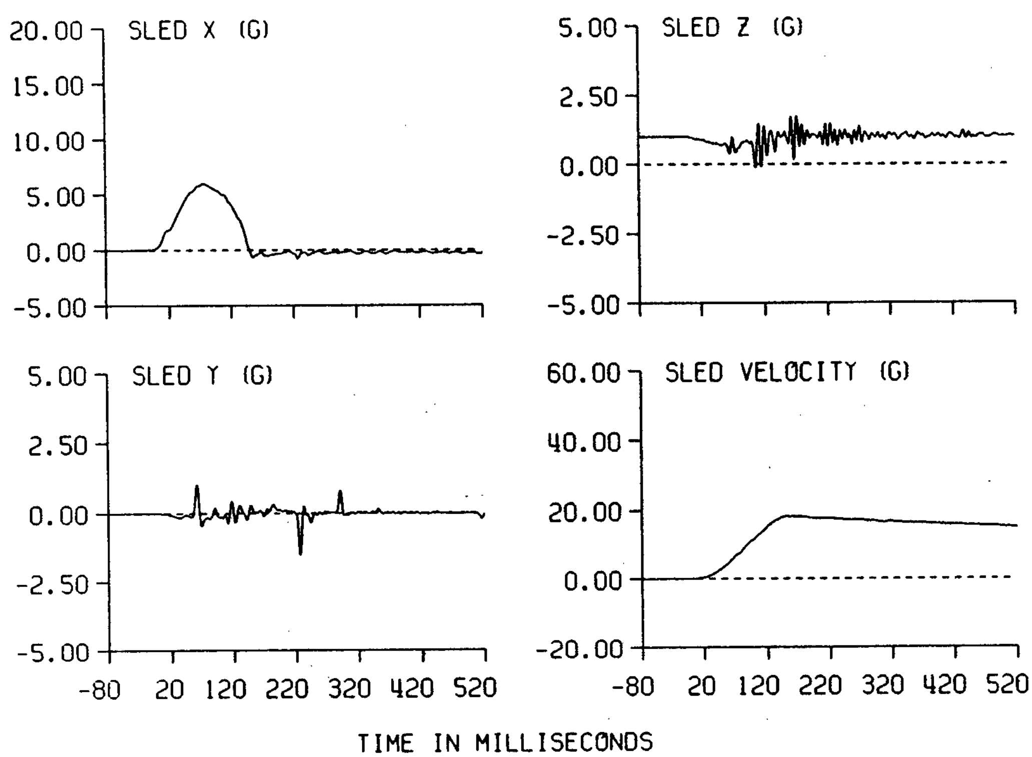
TIME IN MILLISECONDS

JPATS STUDY TEST: 5267 SUBJ: ADAM-L CELL: G

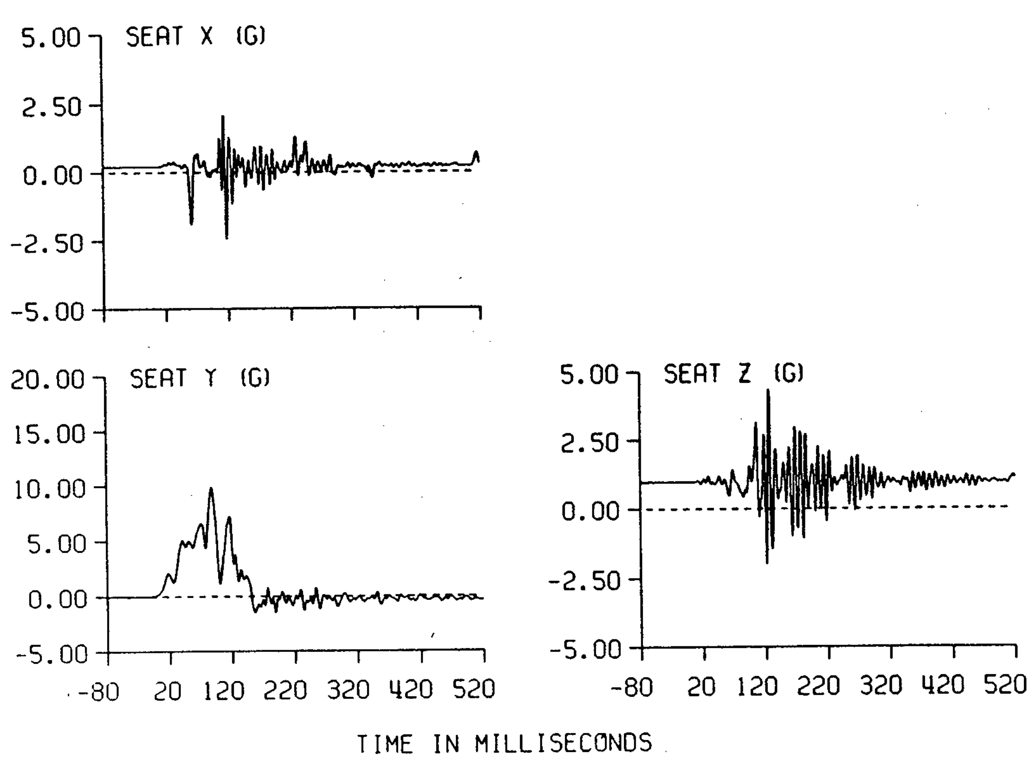


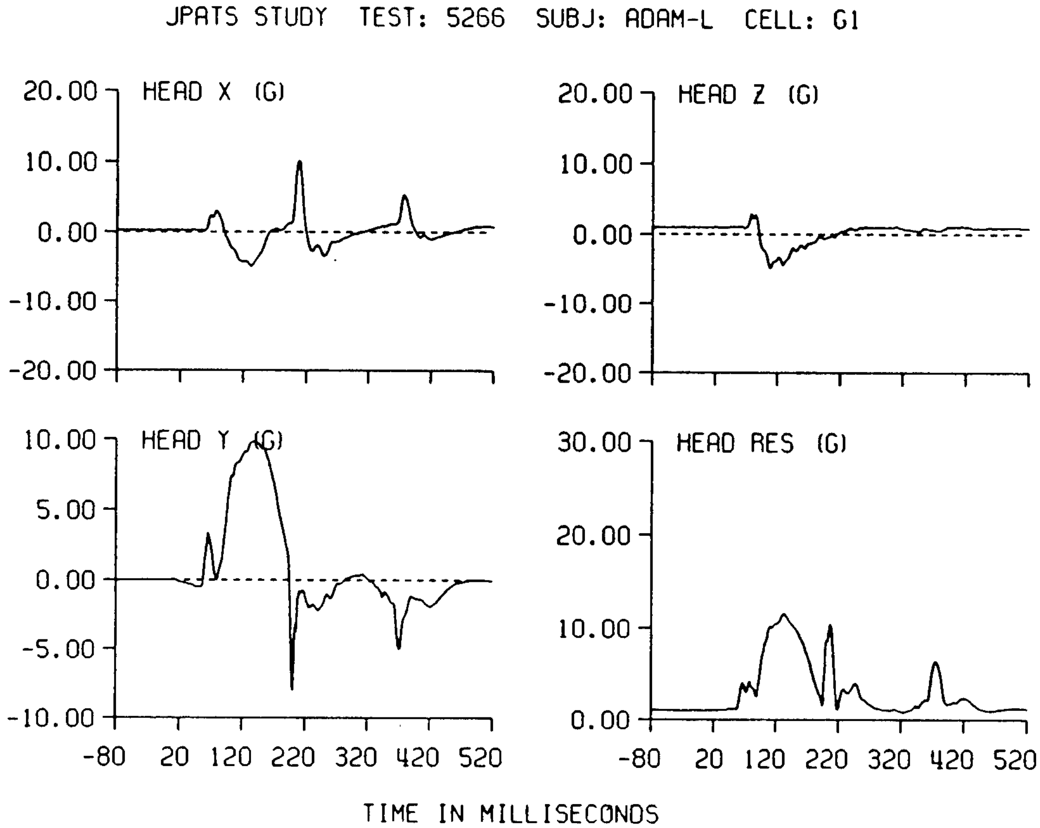
TIME IN MILLISECONDS

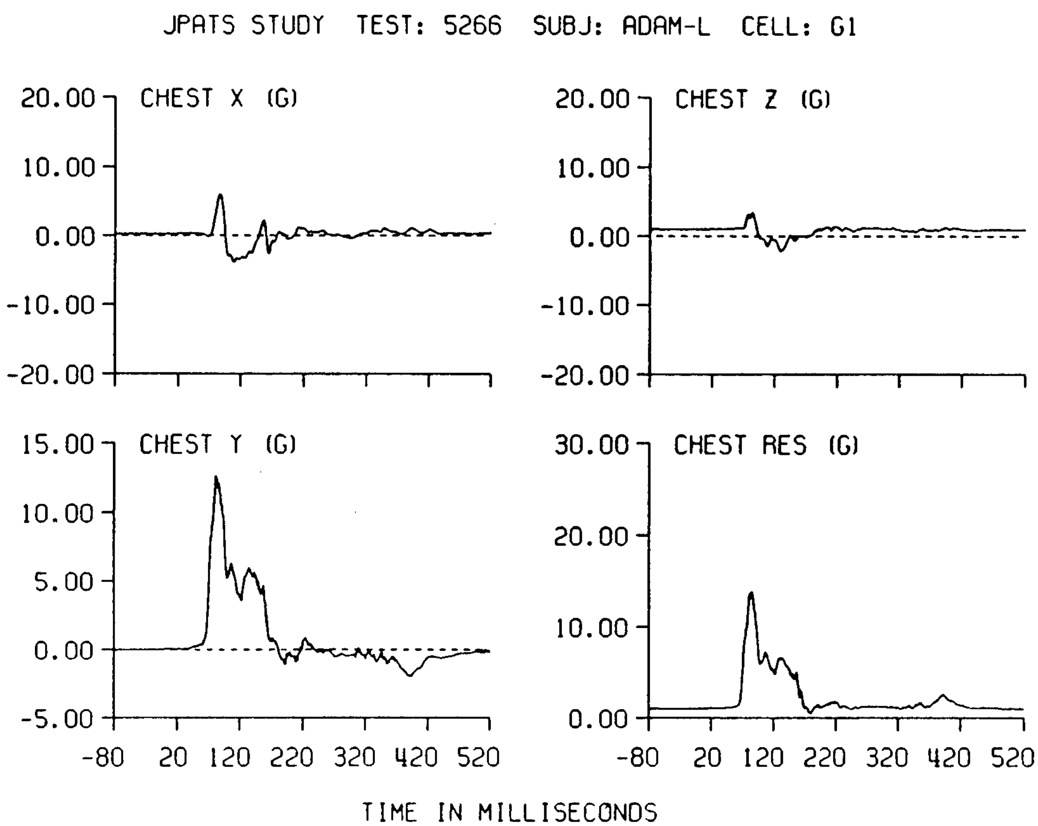
JPATS +GY STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



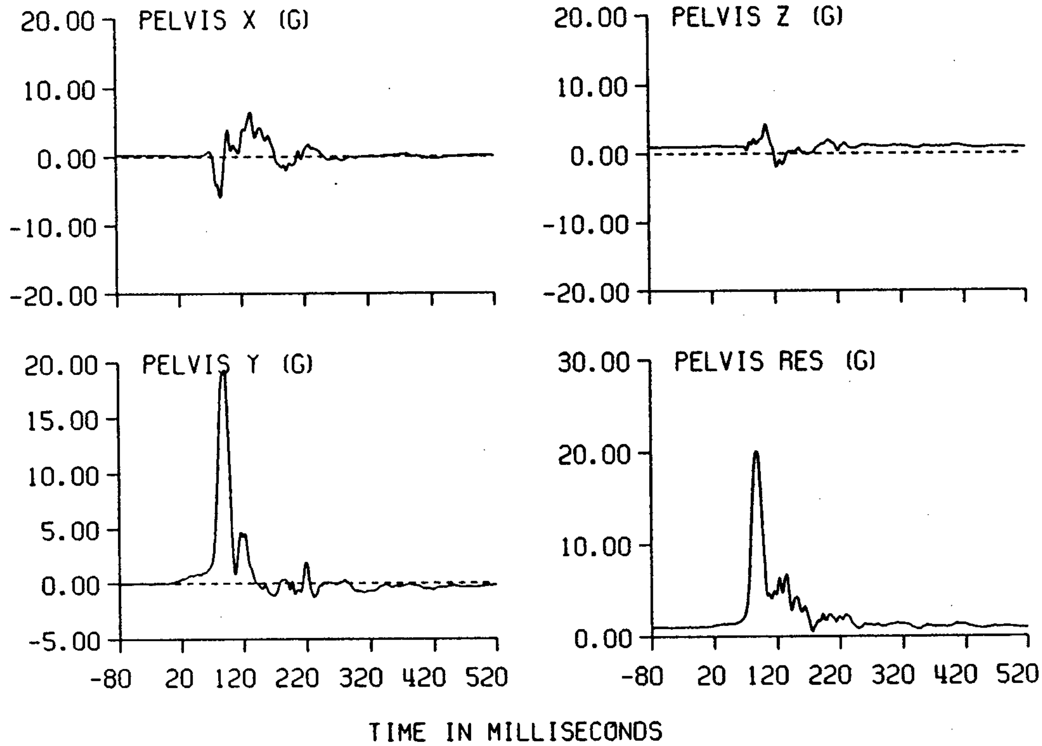
JPATS +GY STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



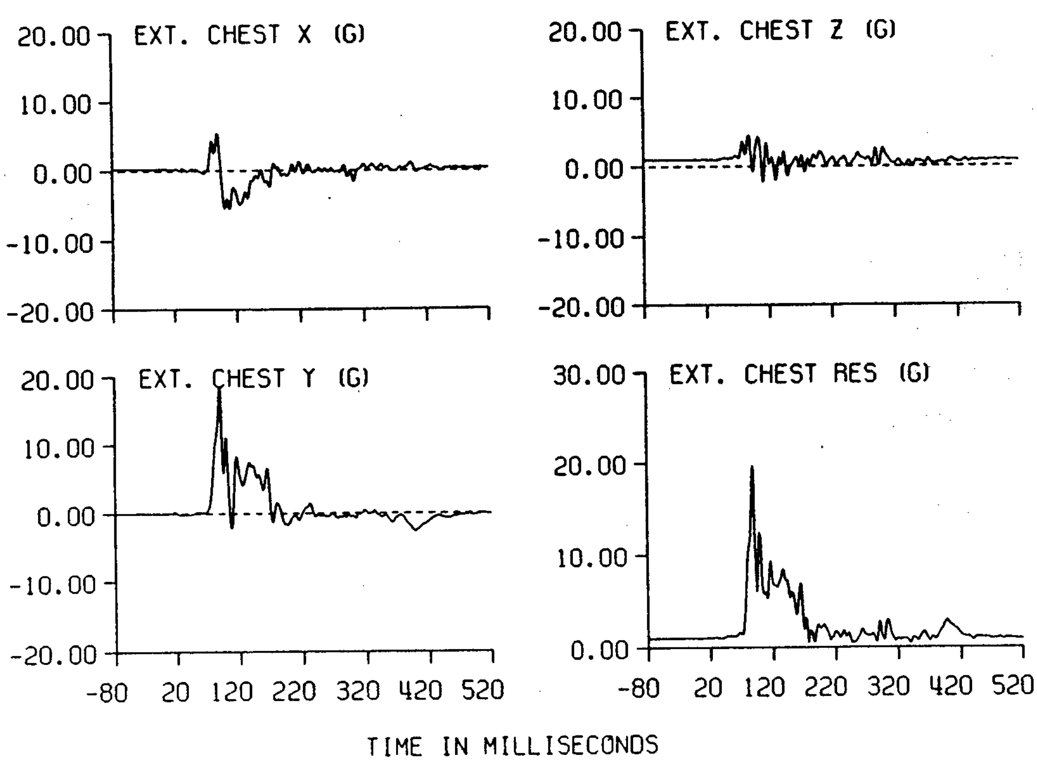

JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1
HEAD X (G)
HEAD Z (G)
HEAD Y (G)
HEAD RES (G)
TIME IN MILLISECONDS


JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1
CHEST X (G)
CHEST Z (G)
CHEST Y (G)
CHEST RES (G)
TIME IN MILLISECONDS

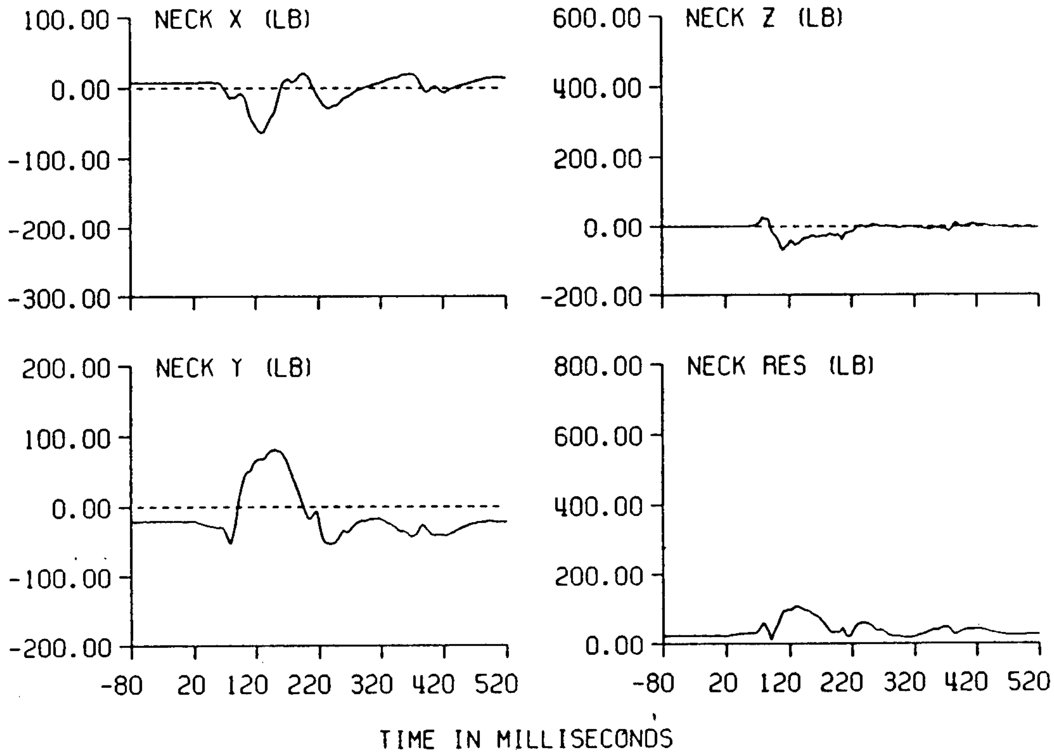
JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



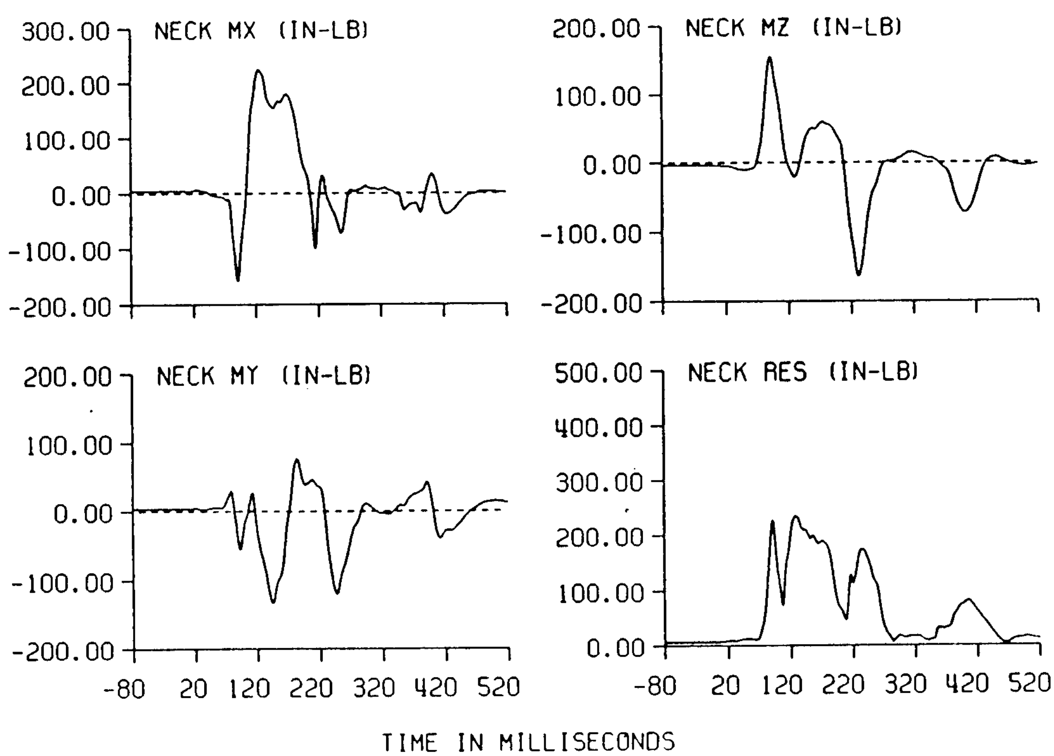
JPATS +GY STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



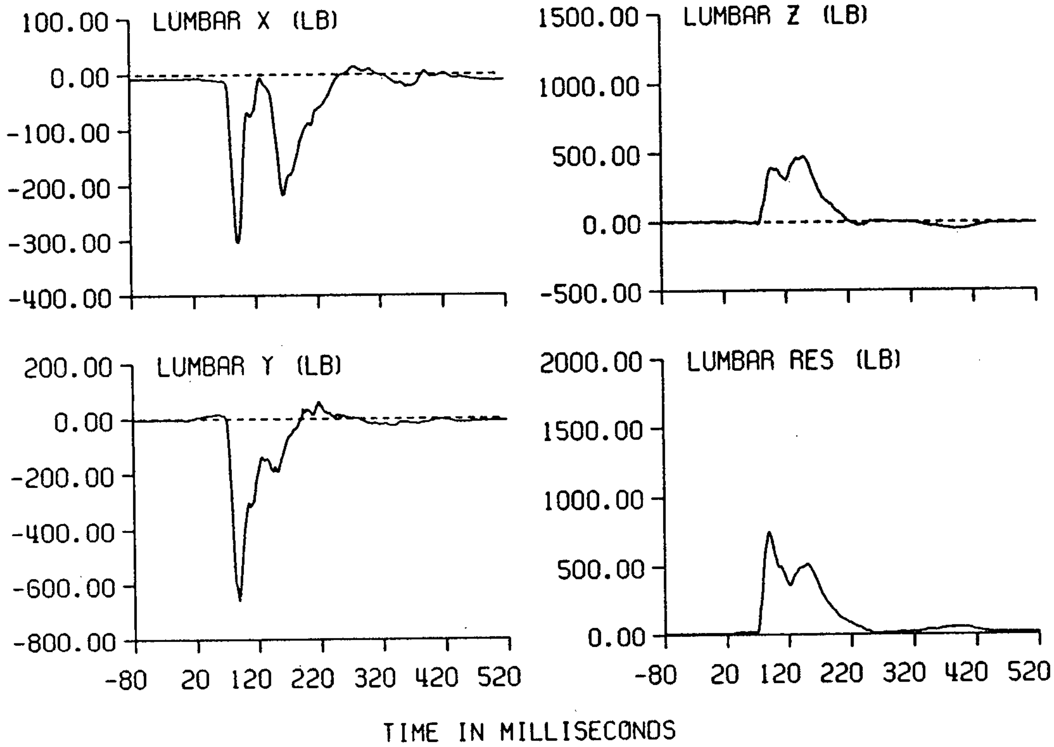
JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



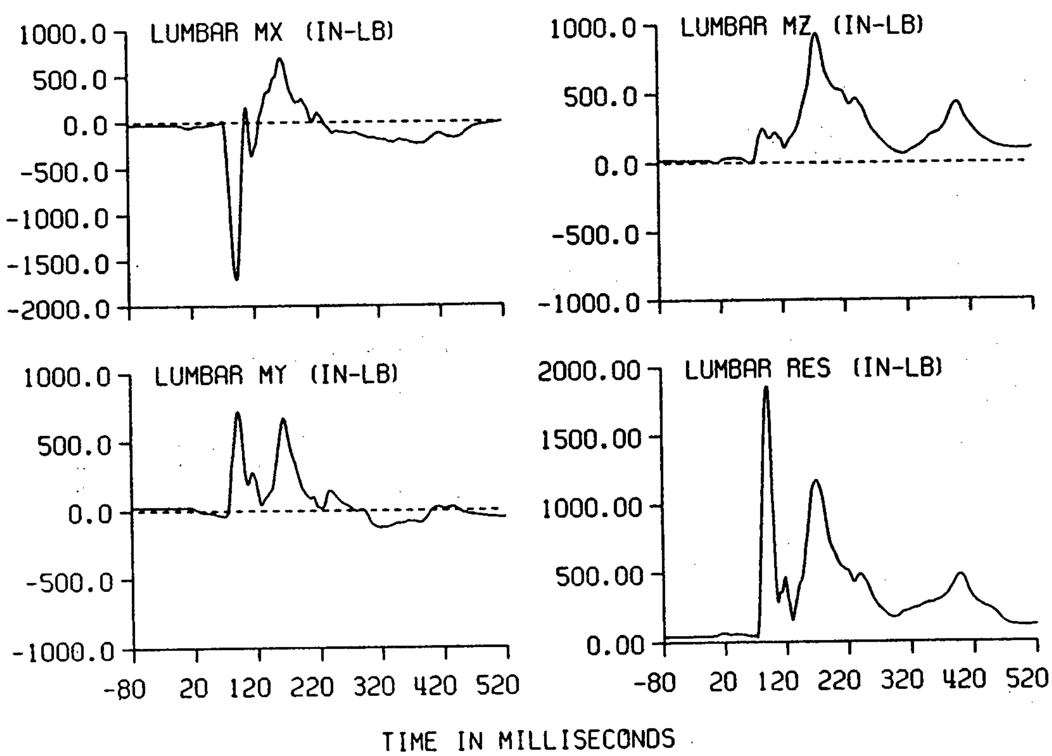
JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



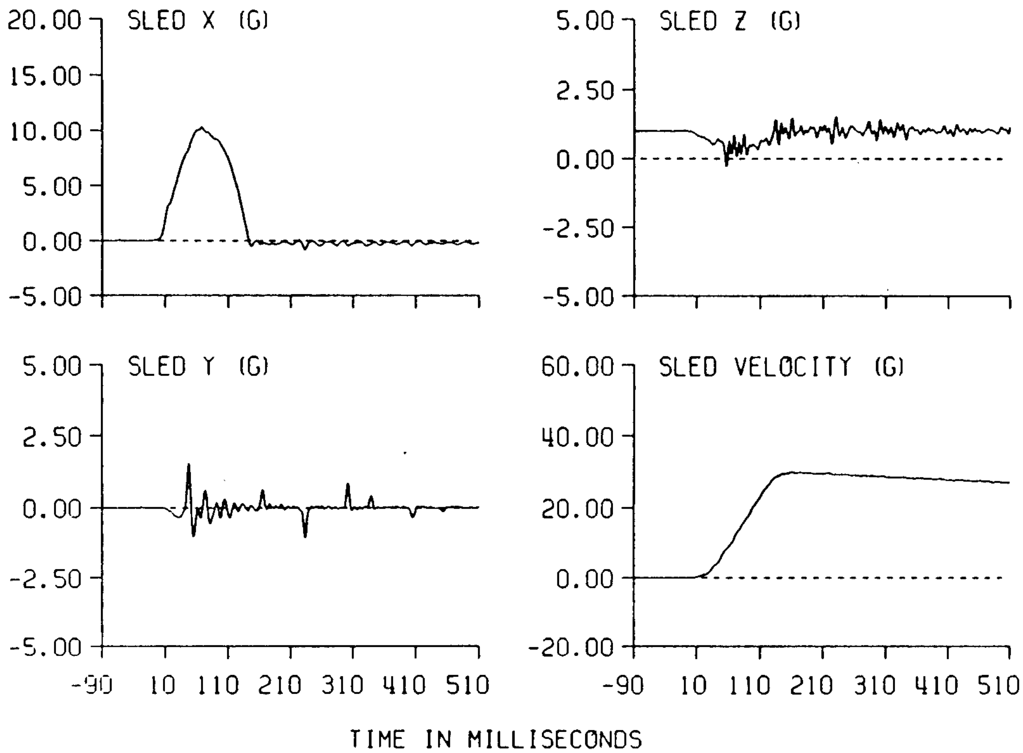
JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



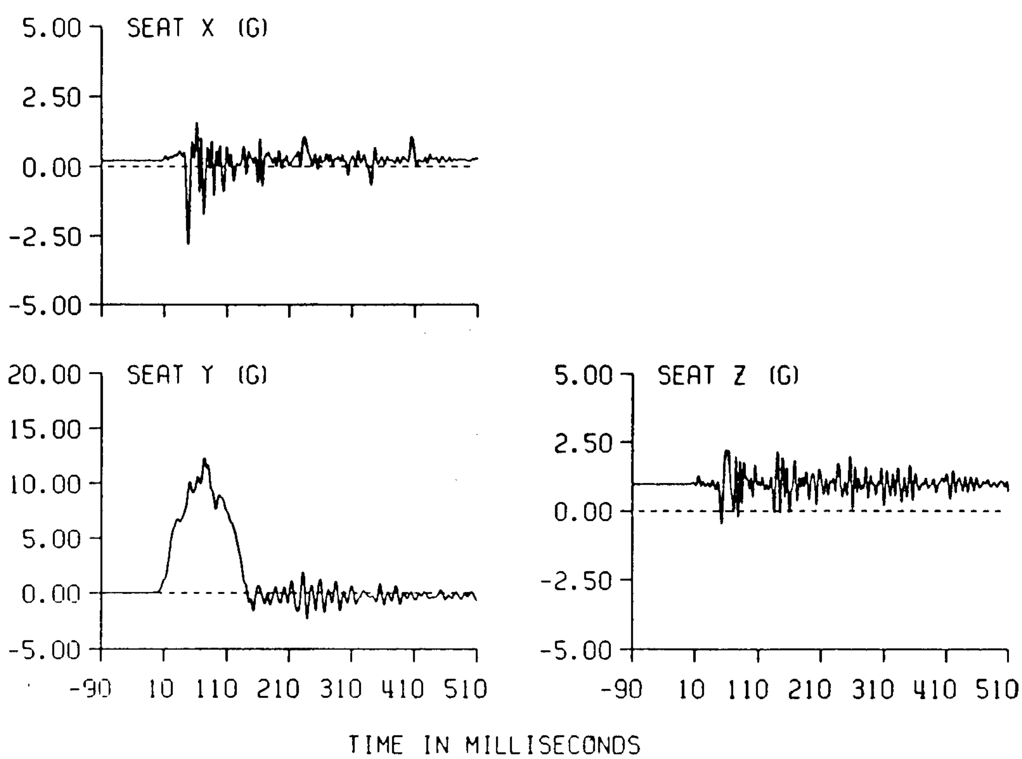
JPATS STUDY TEST: 5266 SUBJ: ADAM-L CELL: G1



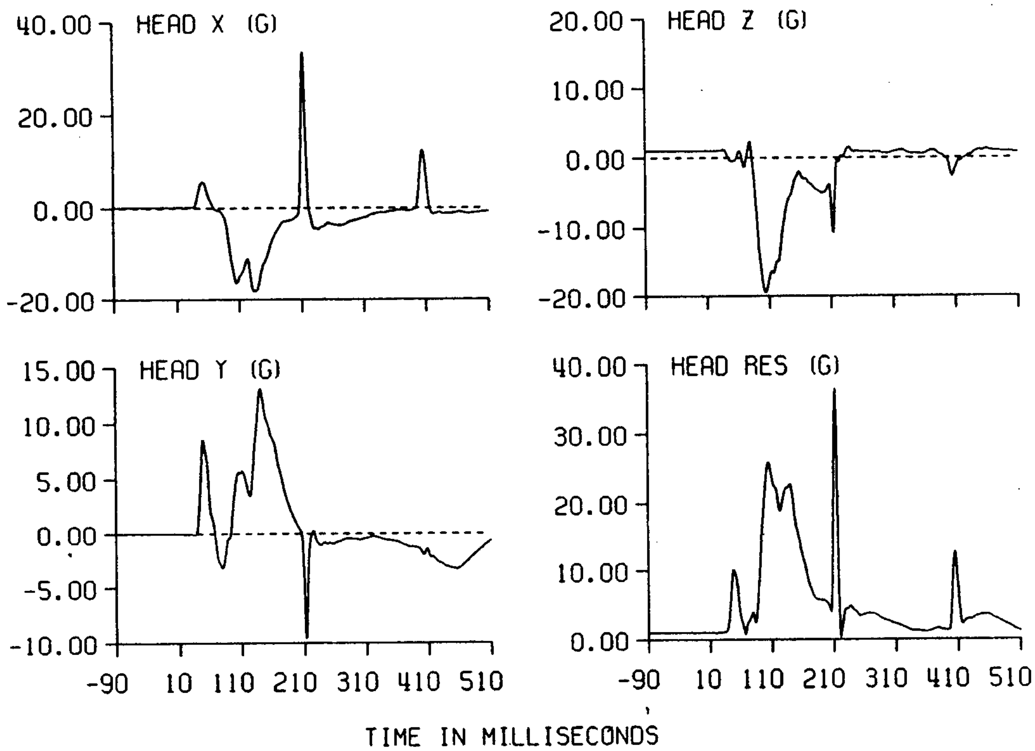
JPATS +GY STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



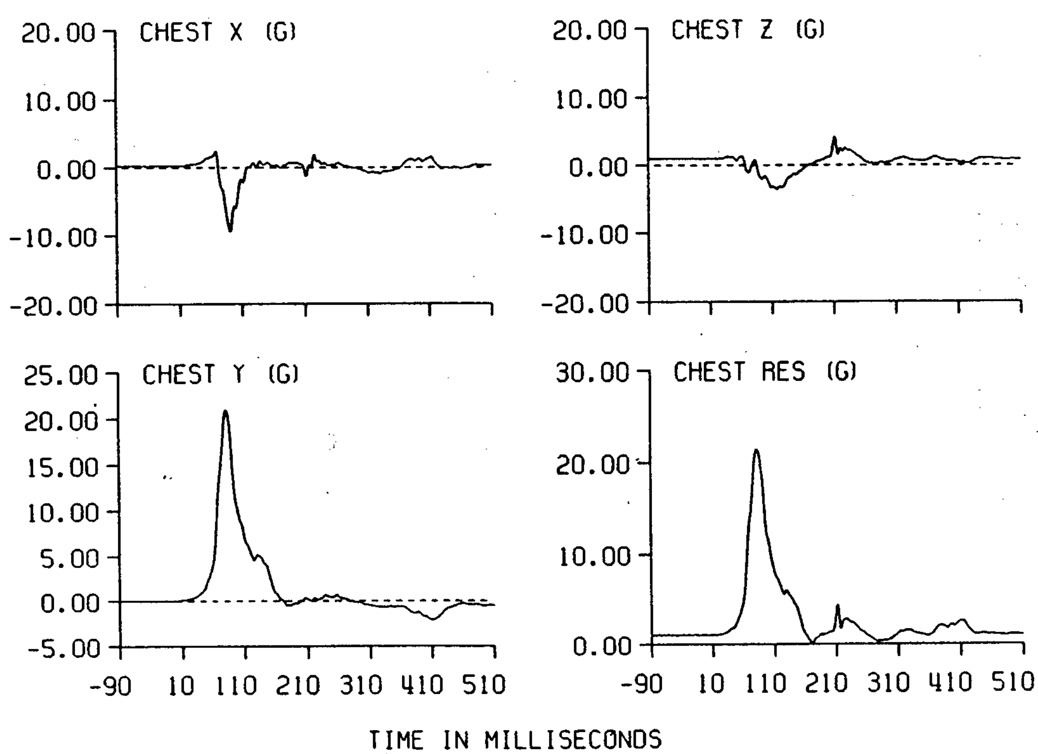
JPATS +GY STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



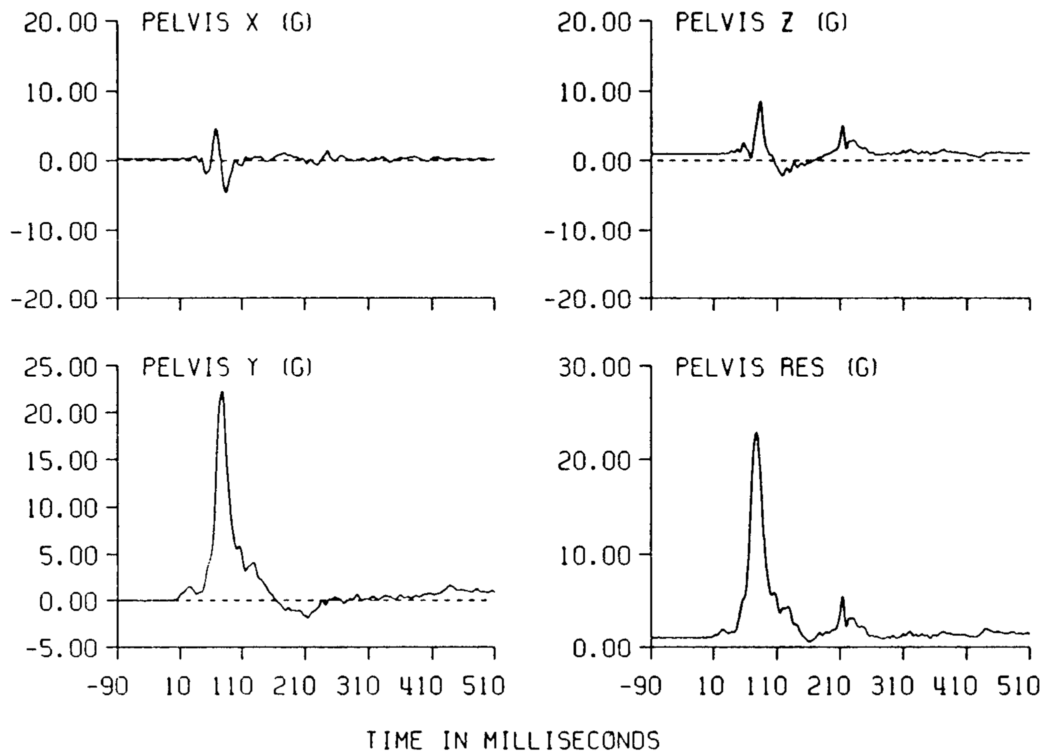
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



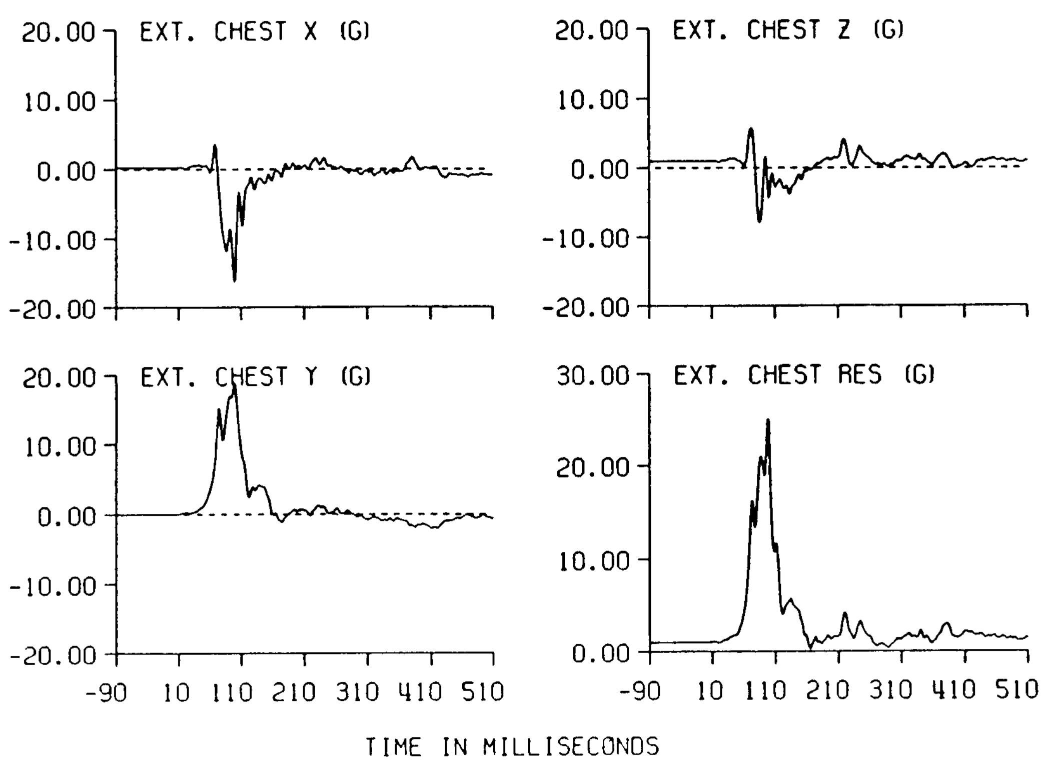
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



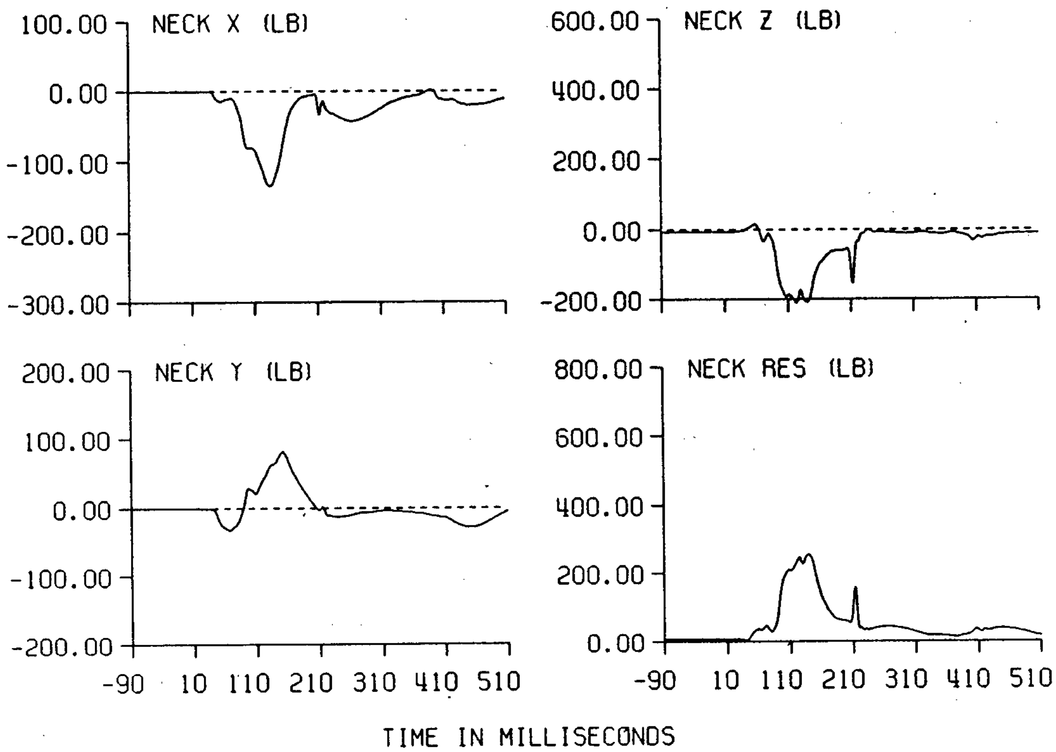
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



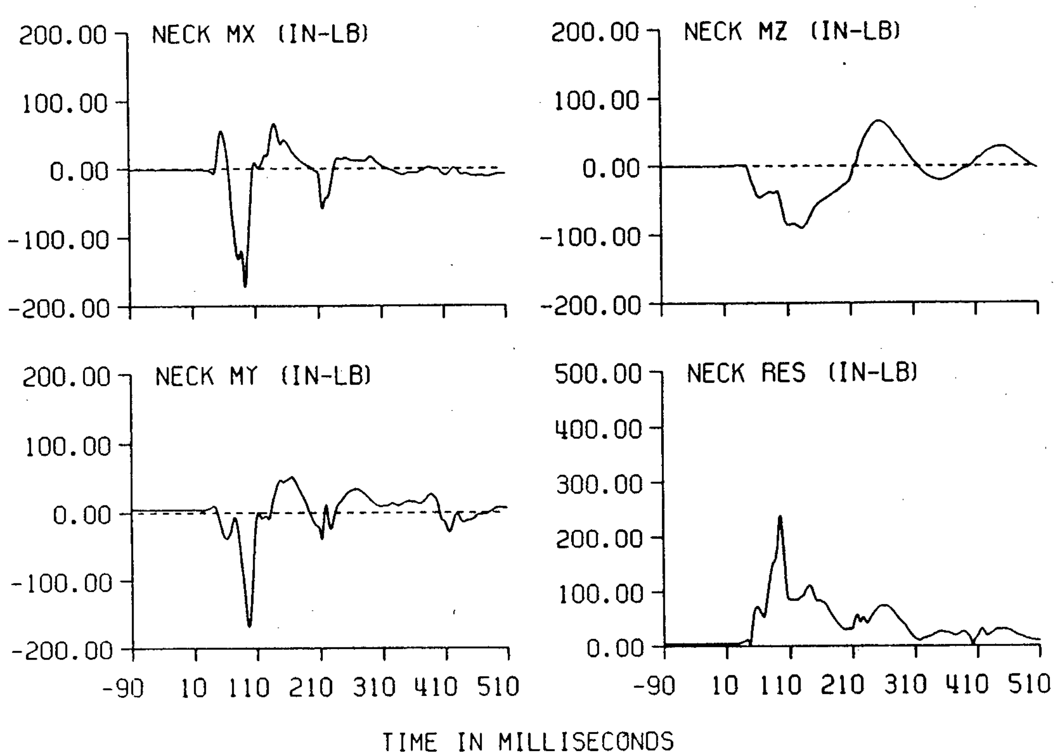
JPATS +GY STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



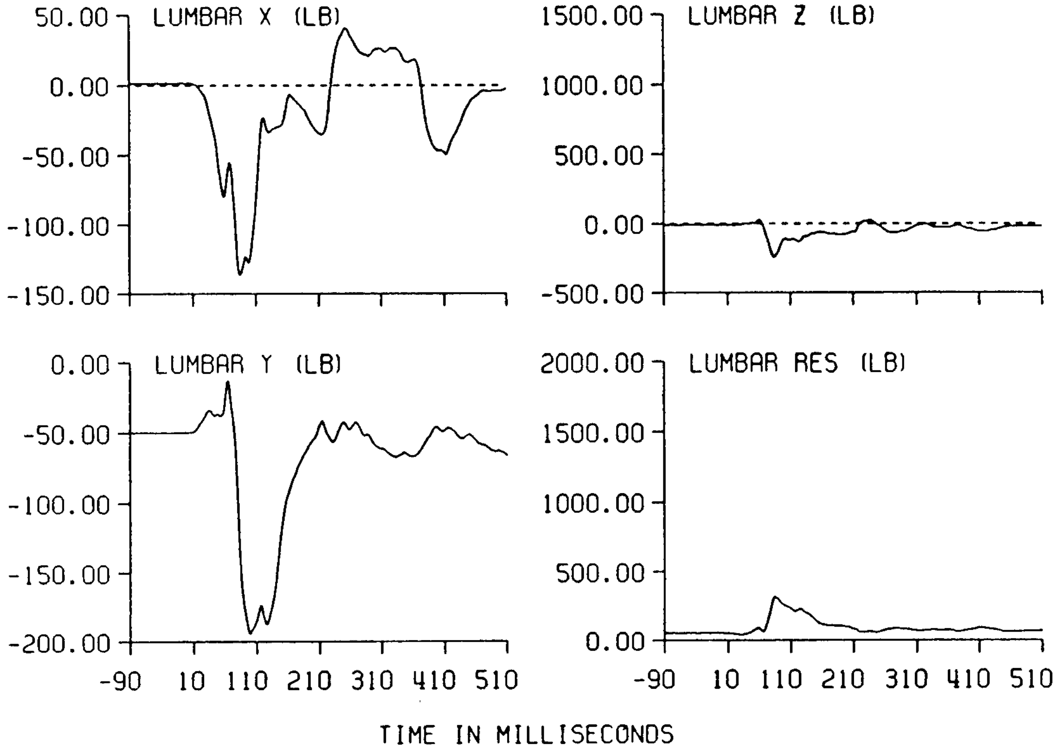
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



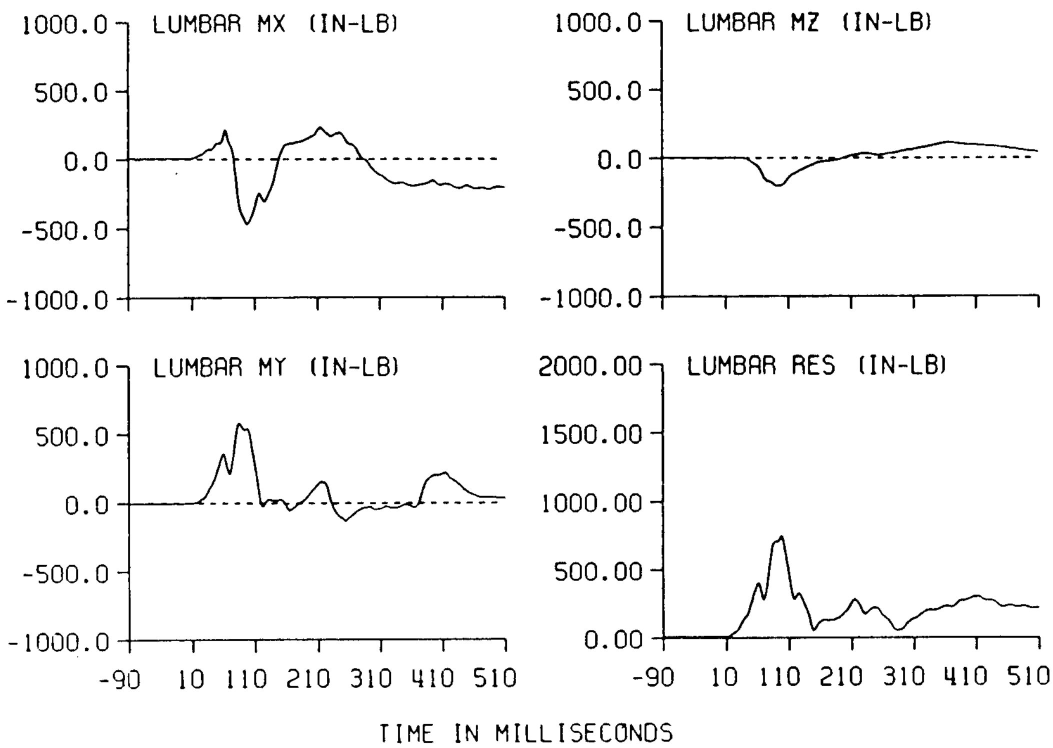
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



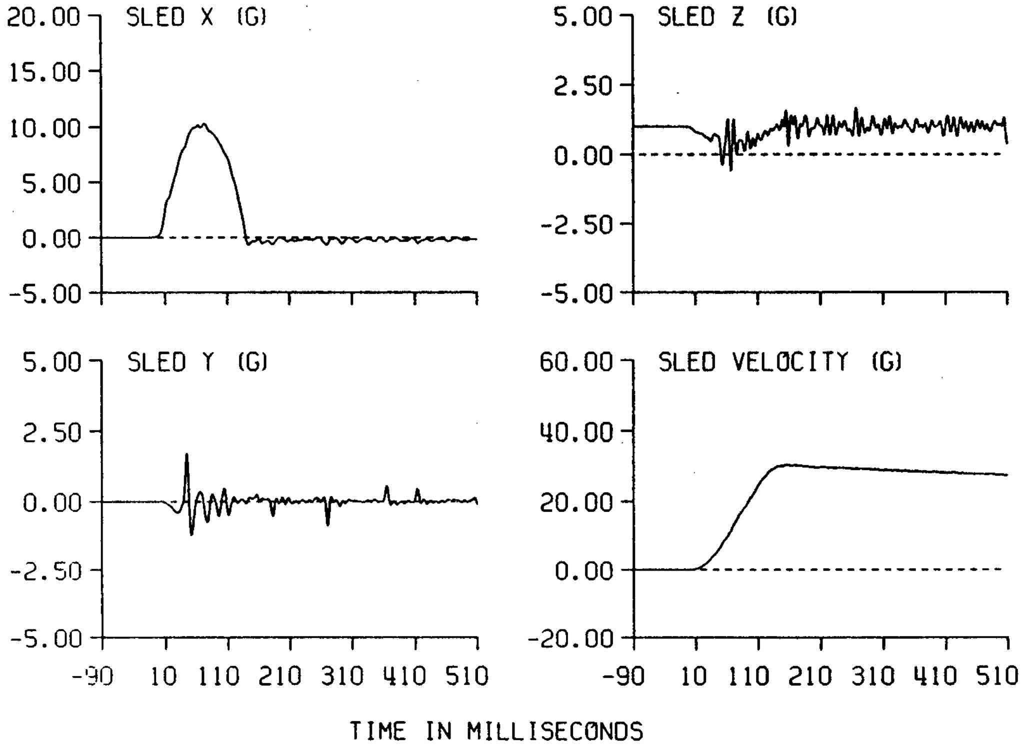
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



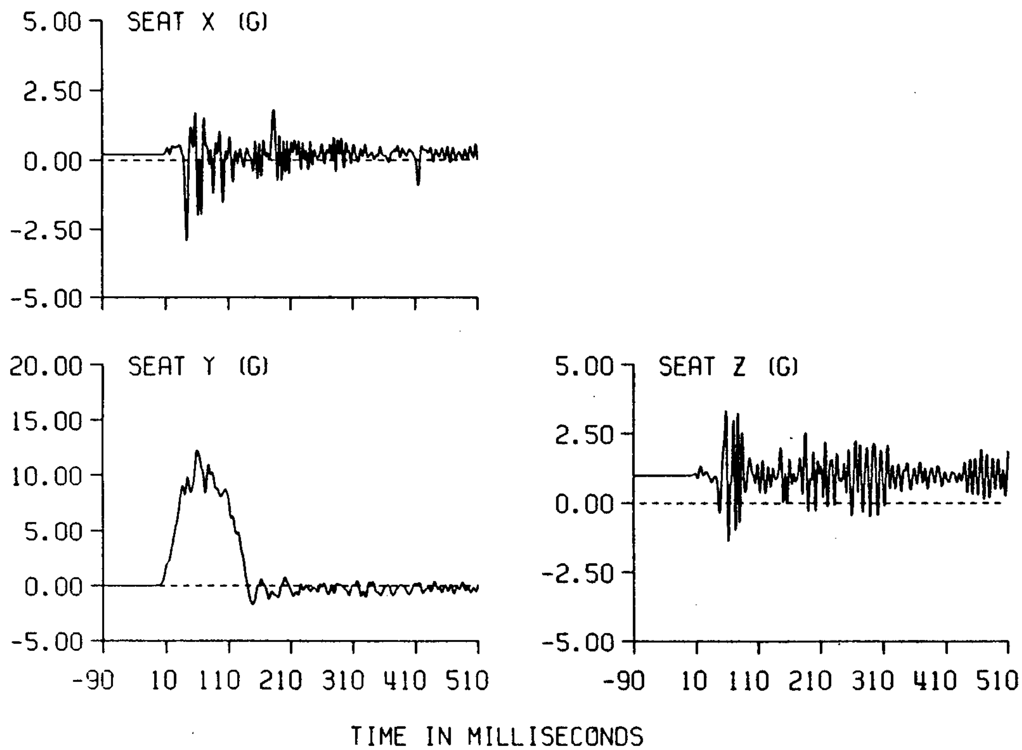
JPATS STUDY TEST: 5253 SUBJ: JPAT-S CELL: H



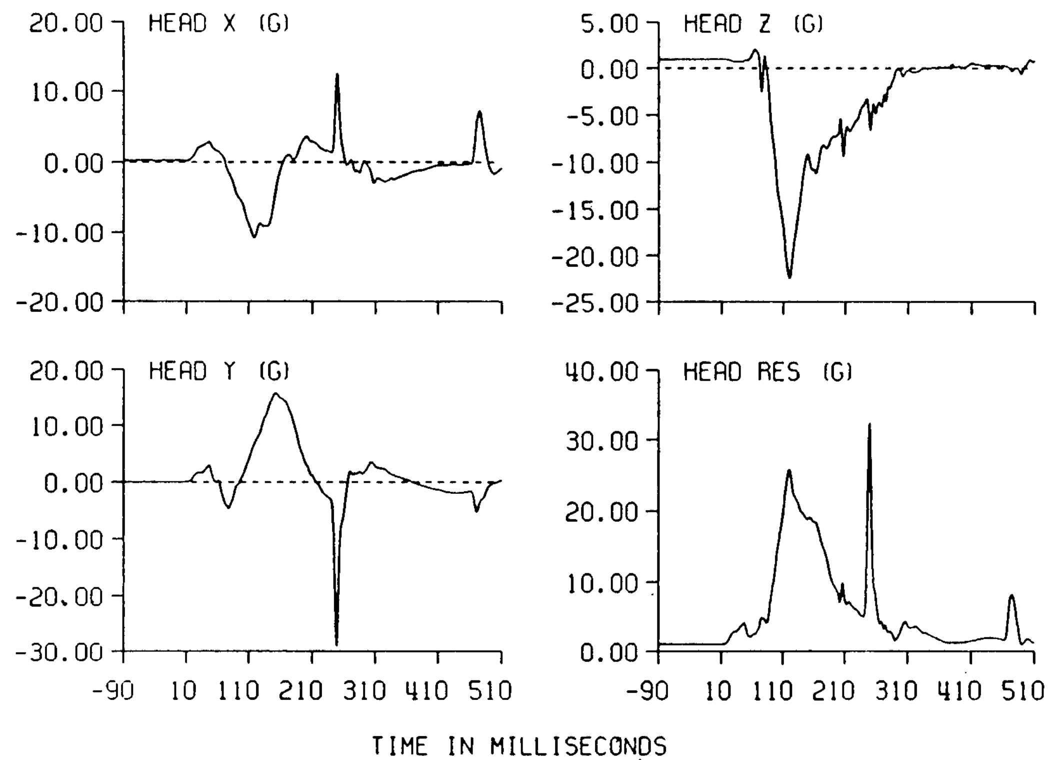
JPATS +GY STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



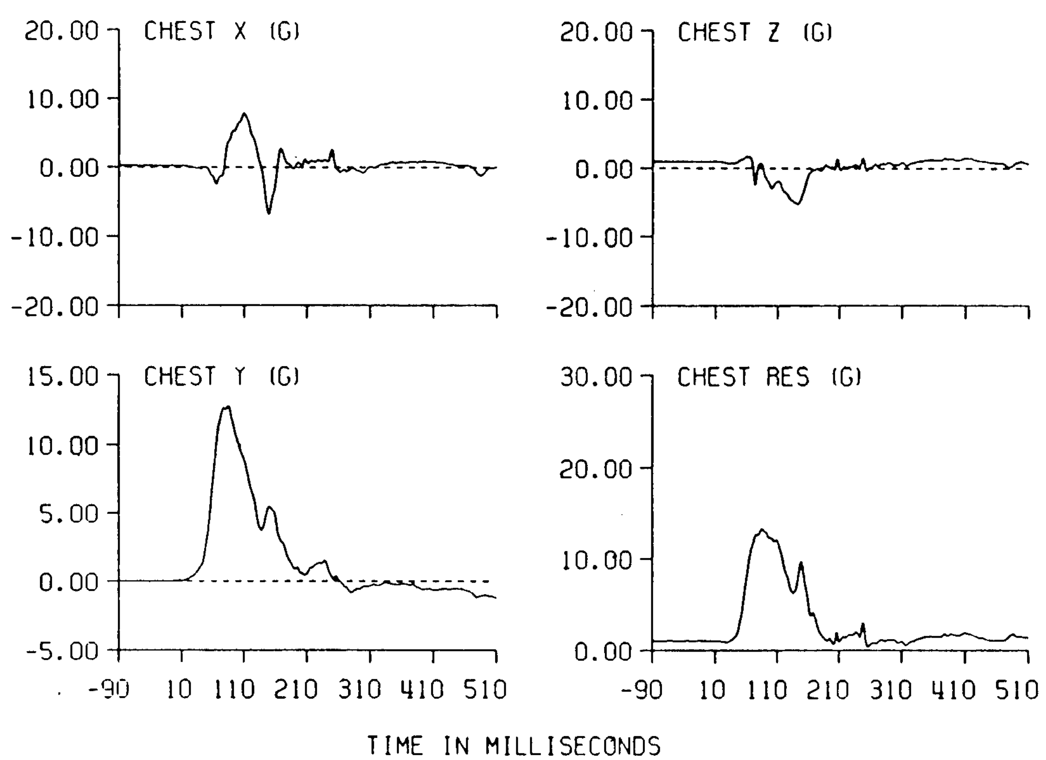
JPATS +GY STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



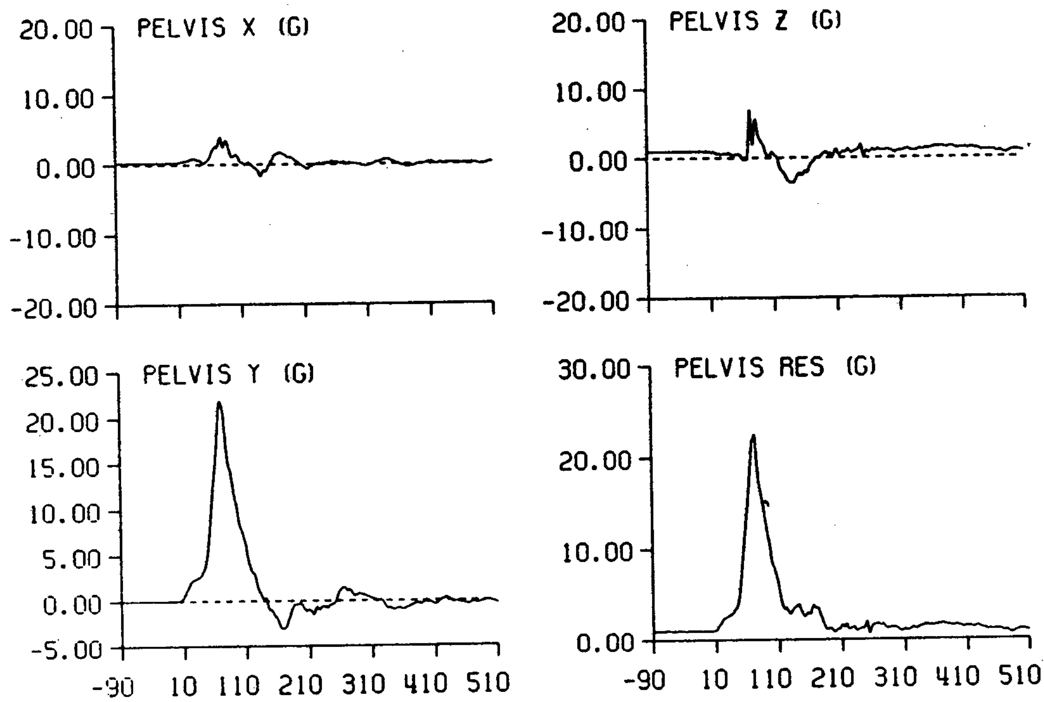
JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H

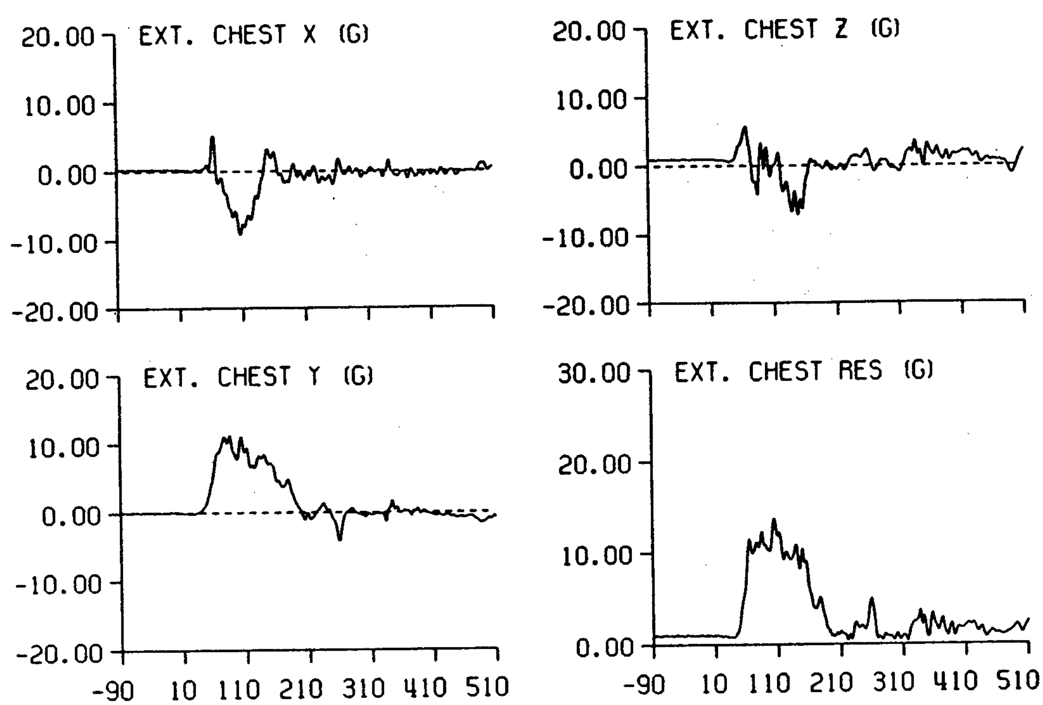


JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



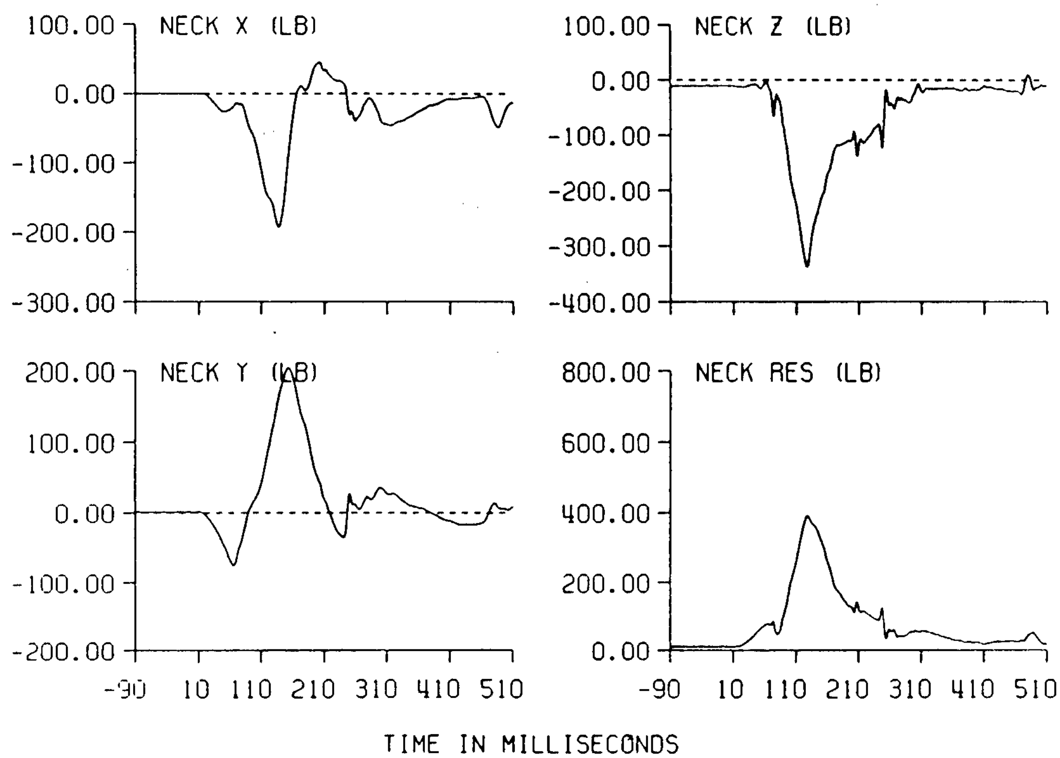
TIME IN MILLISECONDS

JPATS +GY STUDY TEST: 5242 SUBJ: JPAT-L CELL: H

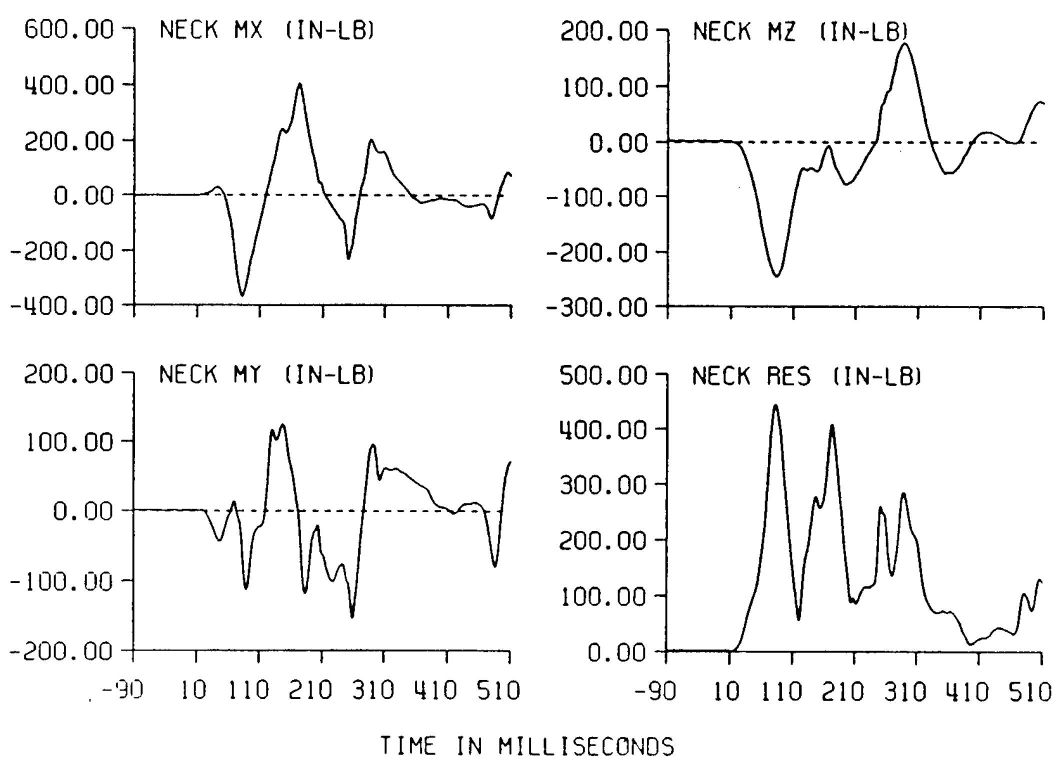


TIME IN MILLISECONDS

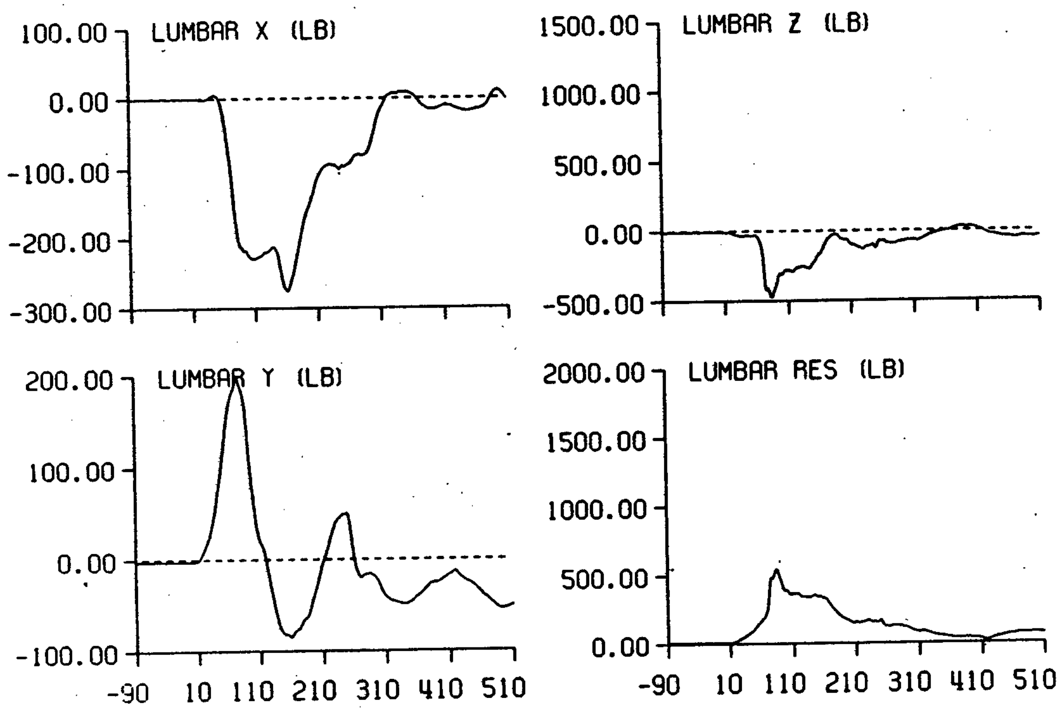
JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H

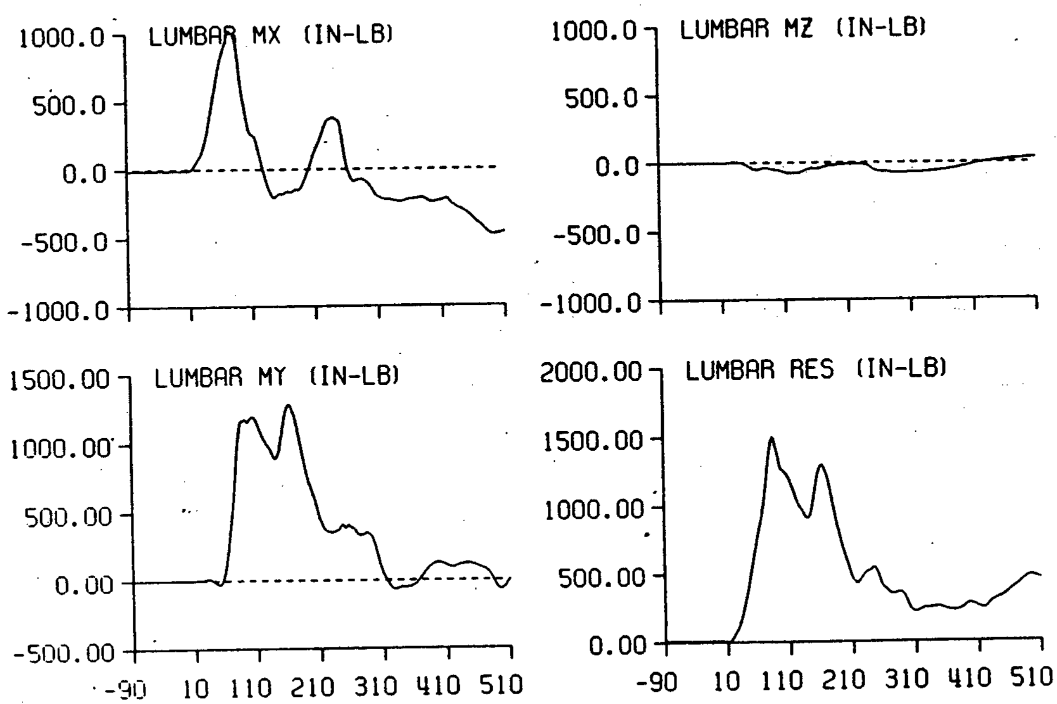


JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H



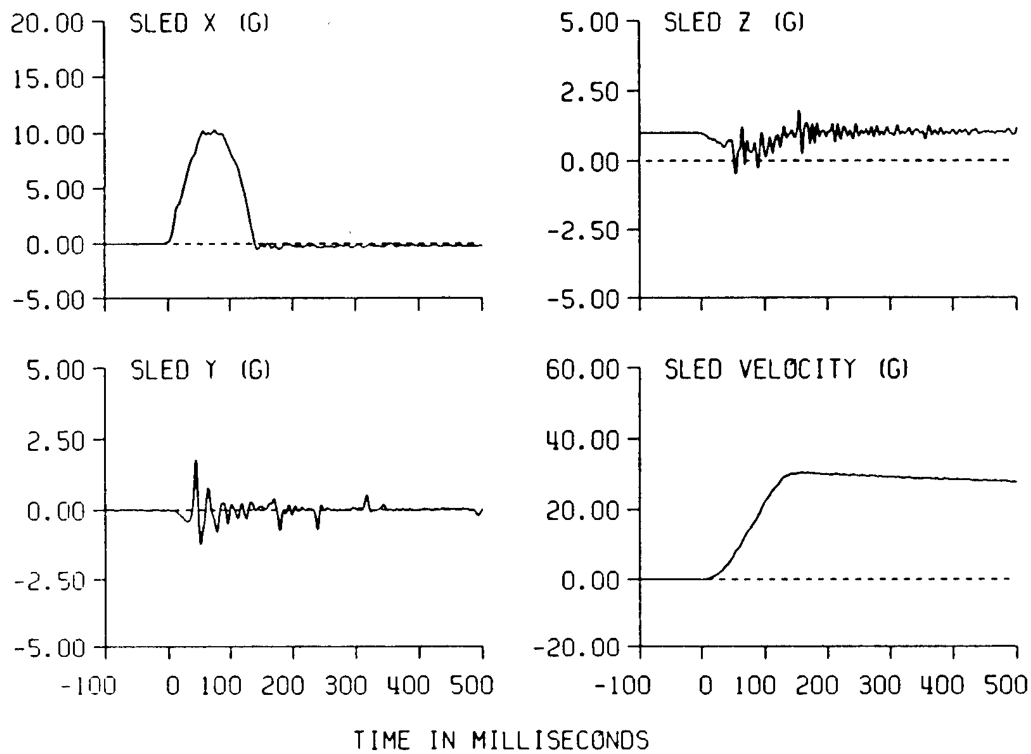
TIME IN MILLISECONDS

JPATS STUDY TEST: 5242 SUBJ: JPAT-L CELL: H

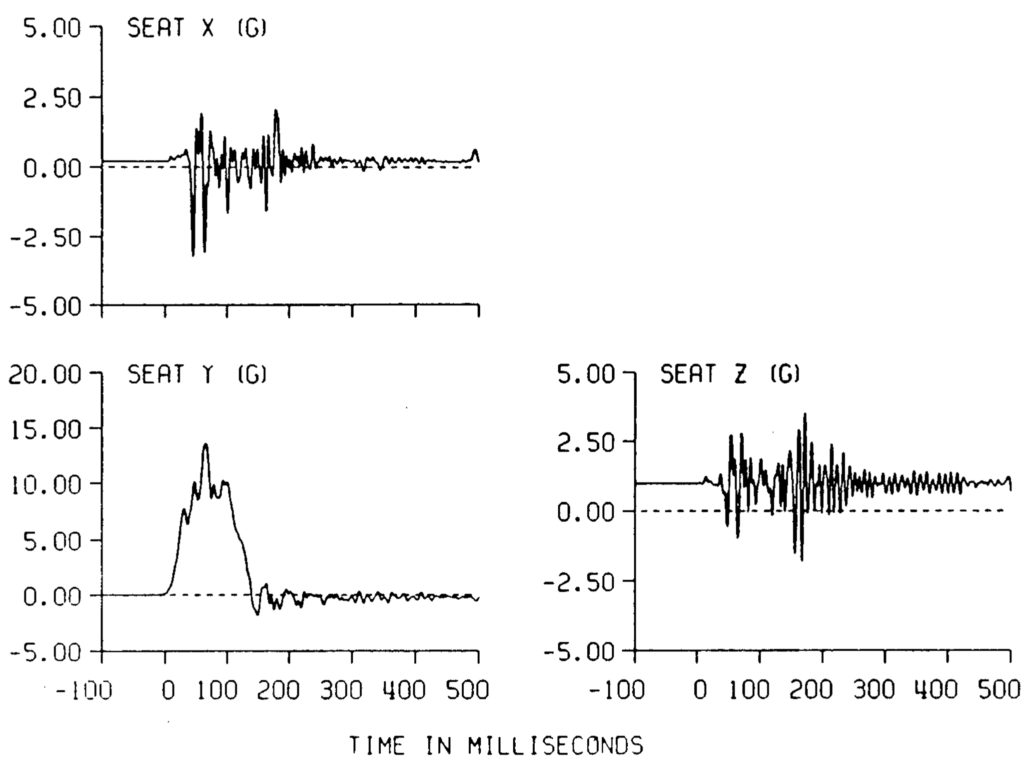


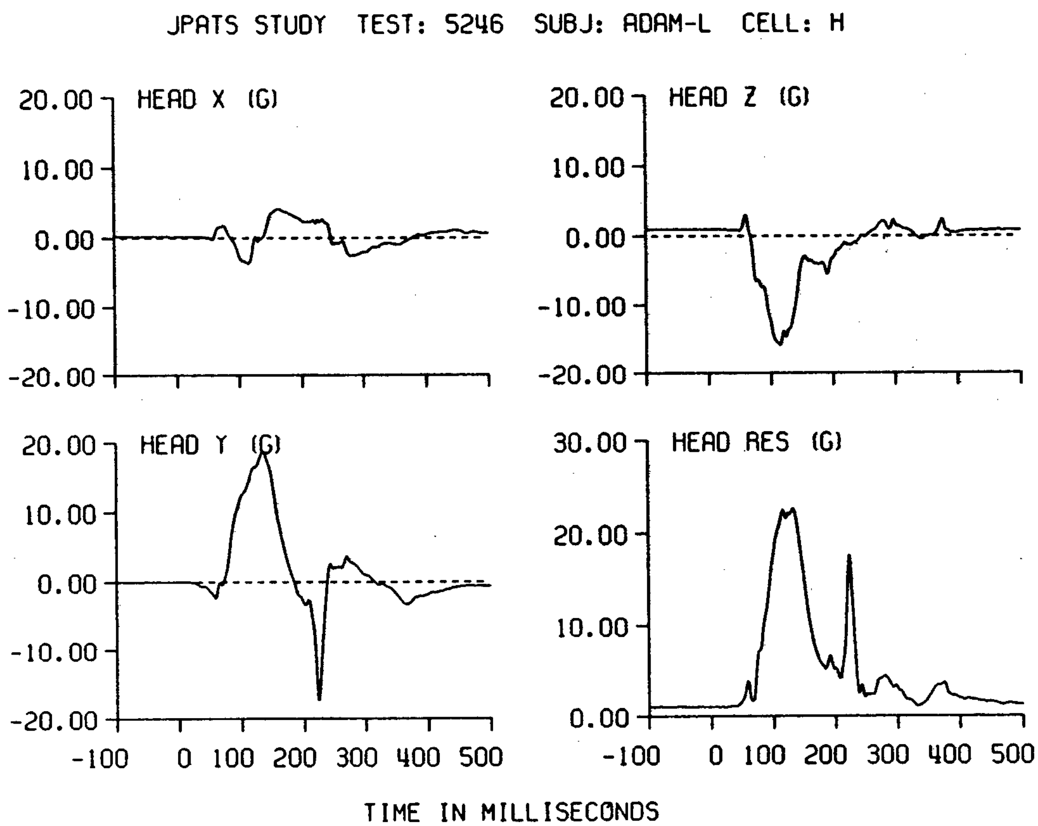
TIME IN MILLISECONDS

JPATS +GY STUDY TEST: 5246 SUBJ: ADAM-L CELL: H

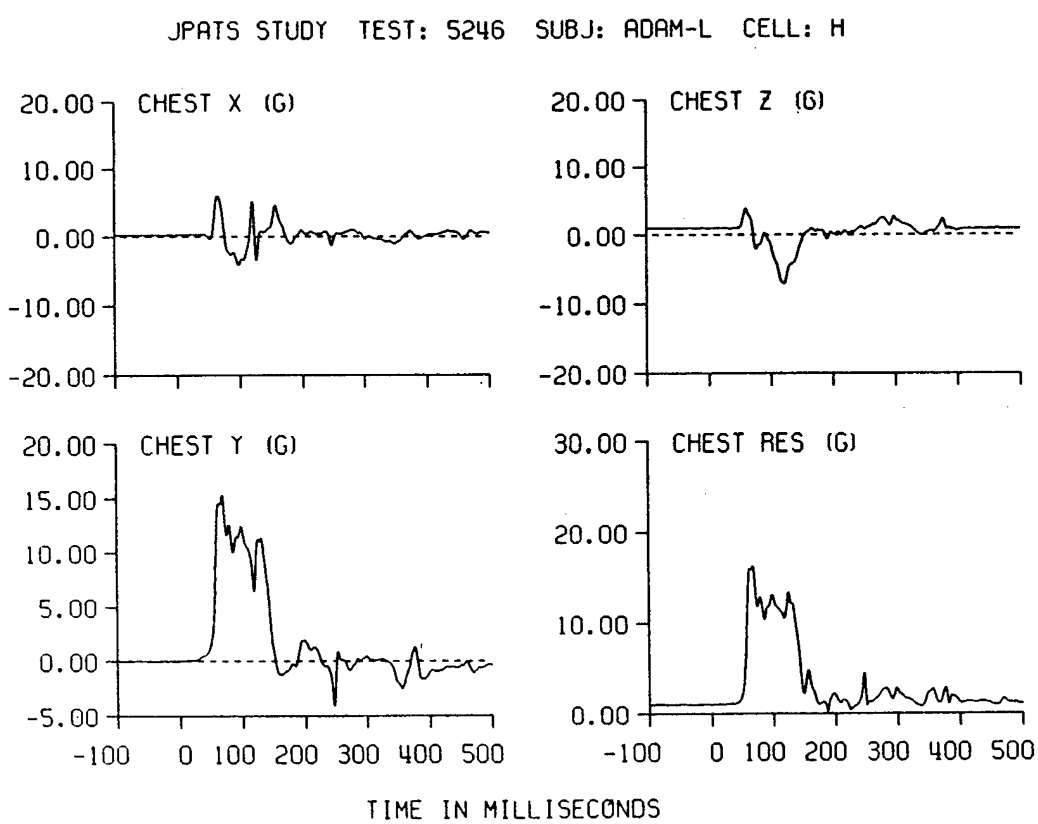


JPATS +GY STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



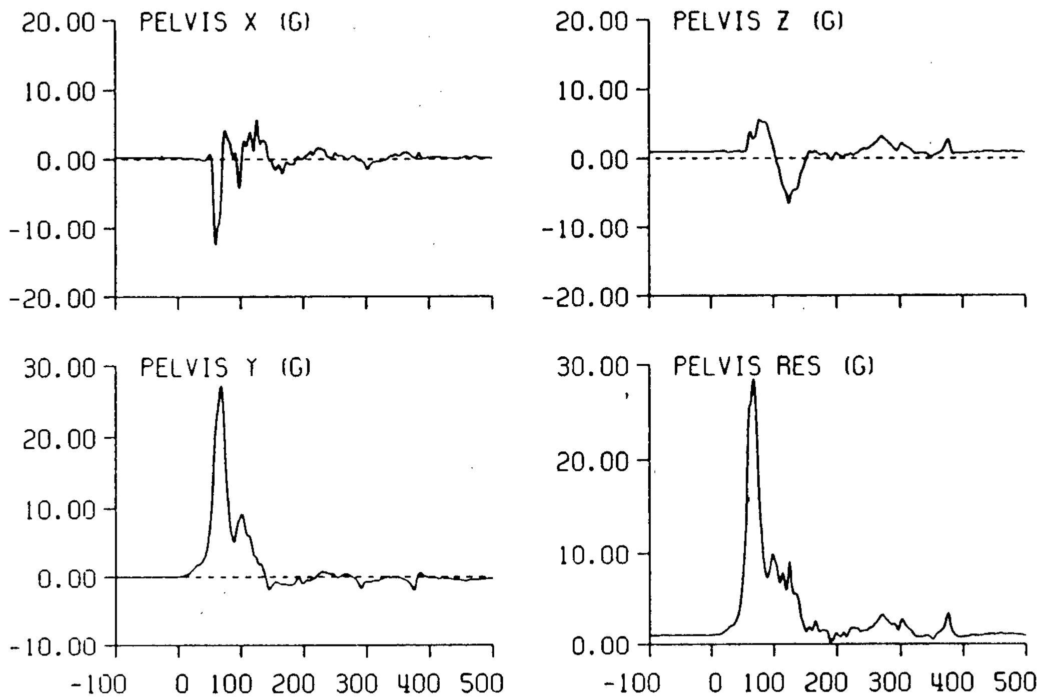


JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H
HEAD X (G)
HEAD Z (G)
HEAD Y (G)
HEAD RES (G)
20.00
10.00
0.00
-10.00
-20.00
30.00
-100 0 100 200 300 400 500
TIME IN MILLISECONDS



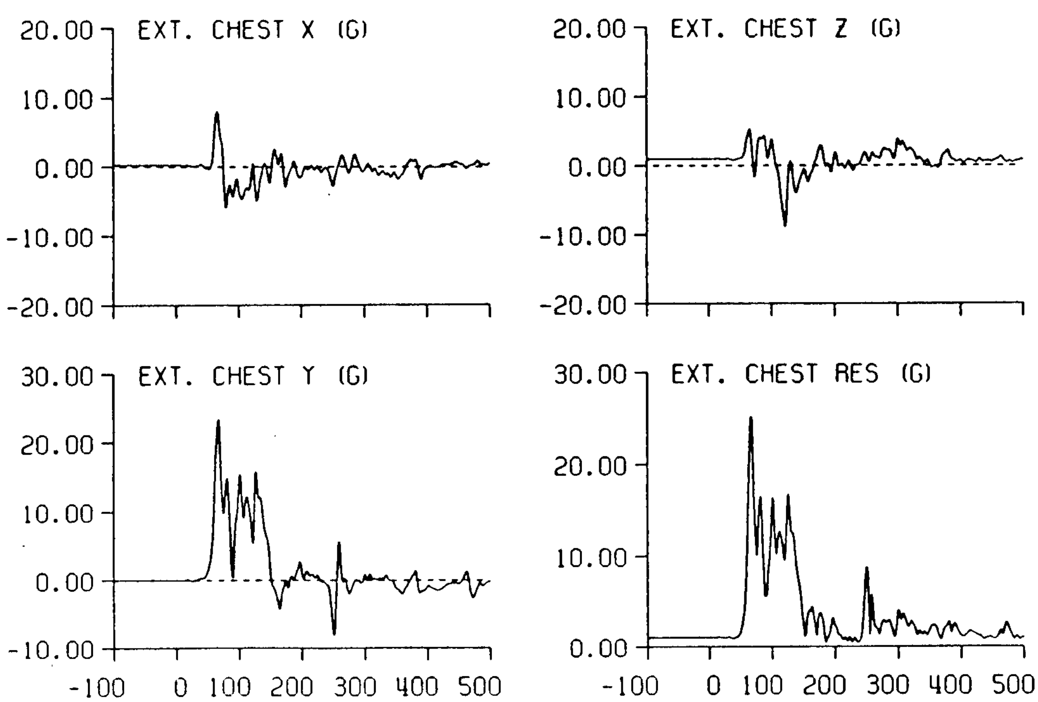
JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H
CHEST X (G)
CHEST Z (G)
CHEST Y (G)
CHEST RES (G)
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-20.00
30.00
-100 0 100 200 300 400 500
TIME IN MILLISECONDS

JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



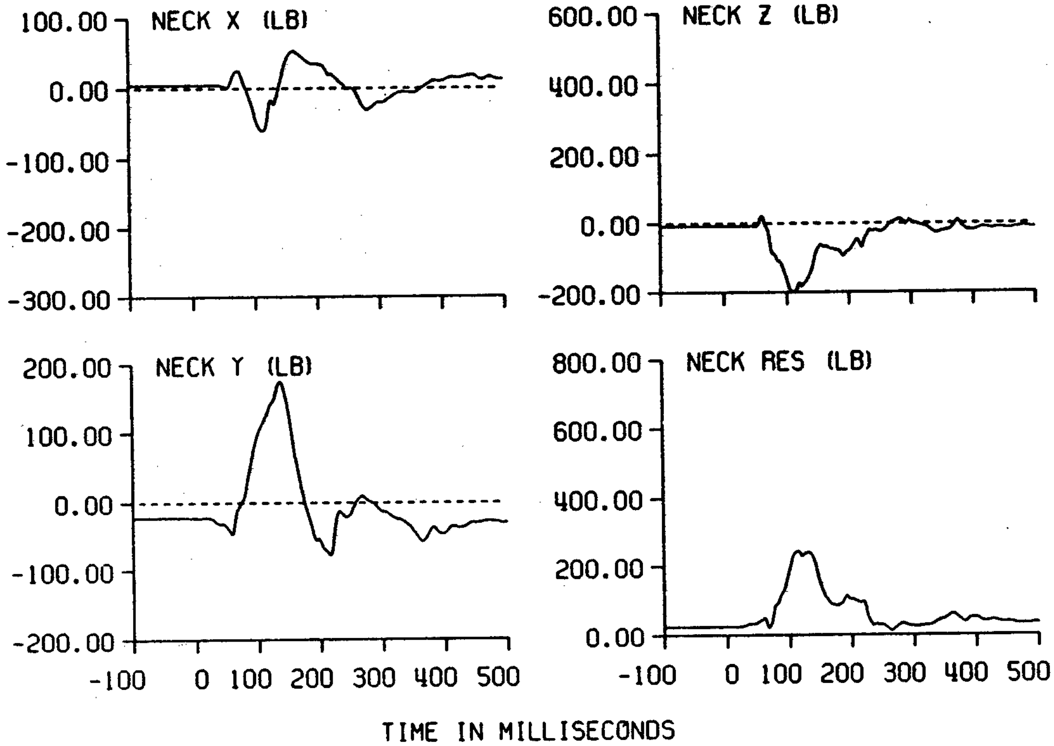
TIME IN MILLISECONDS

JPATS +GY STUDY TEST: 5246 SUBJ: ADAM-L CELL: H

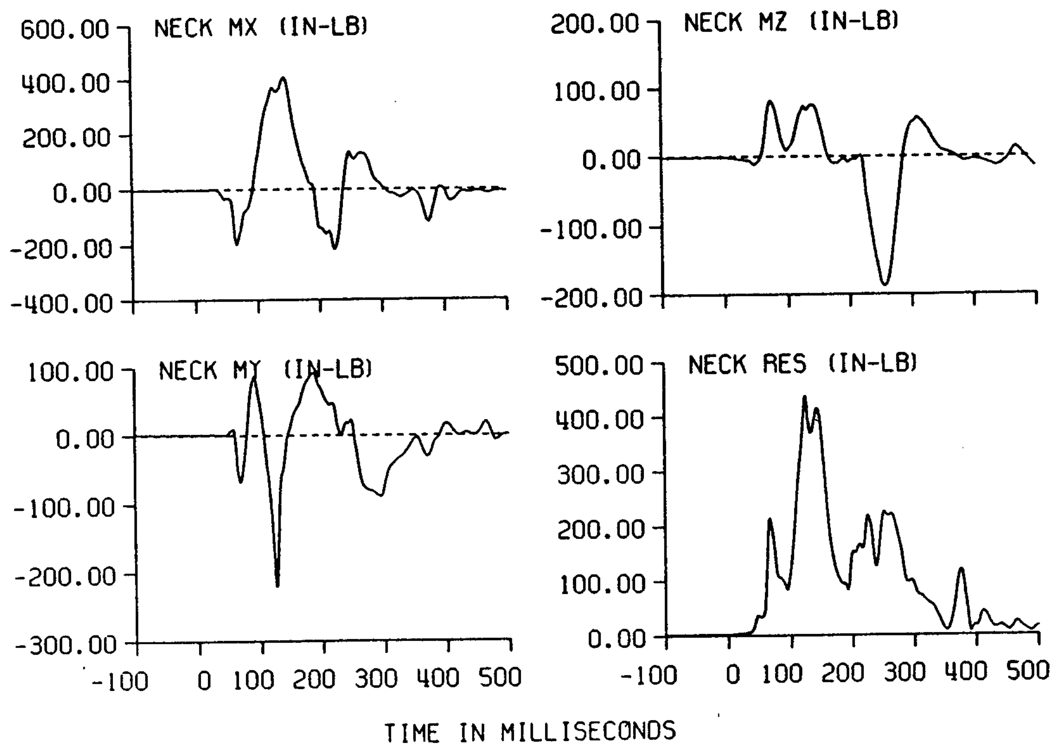


TIME IN MILLISECONDS

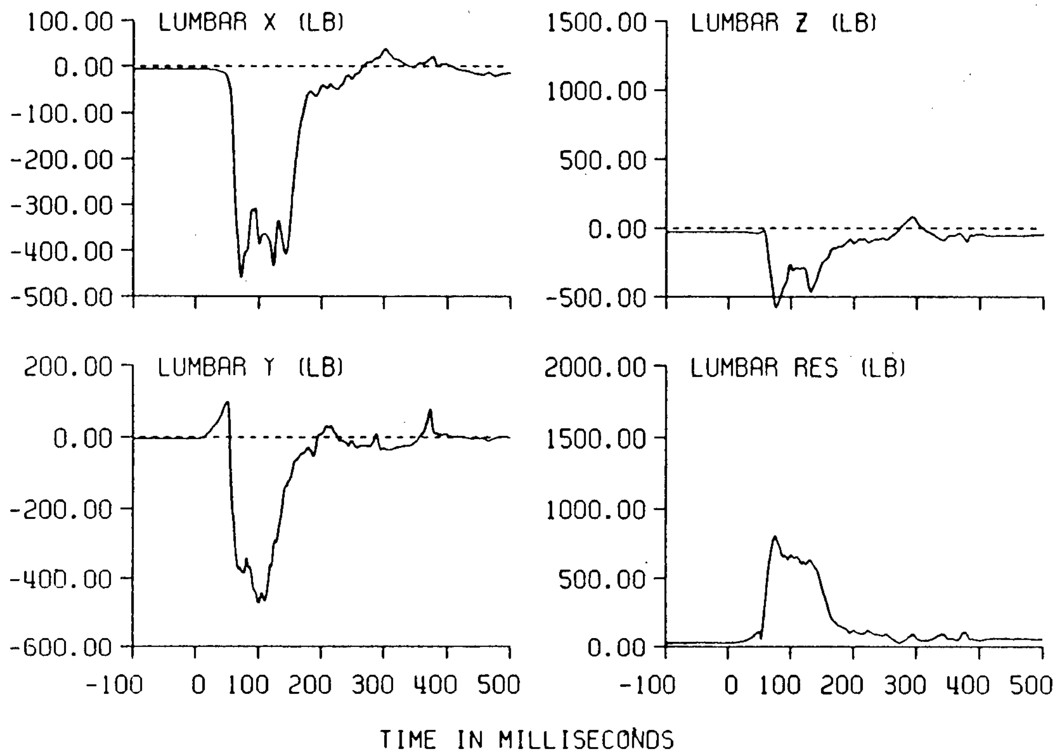
JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



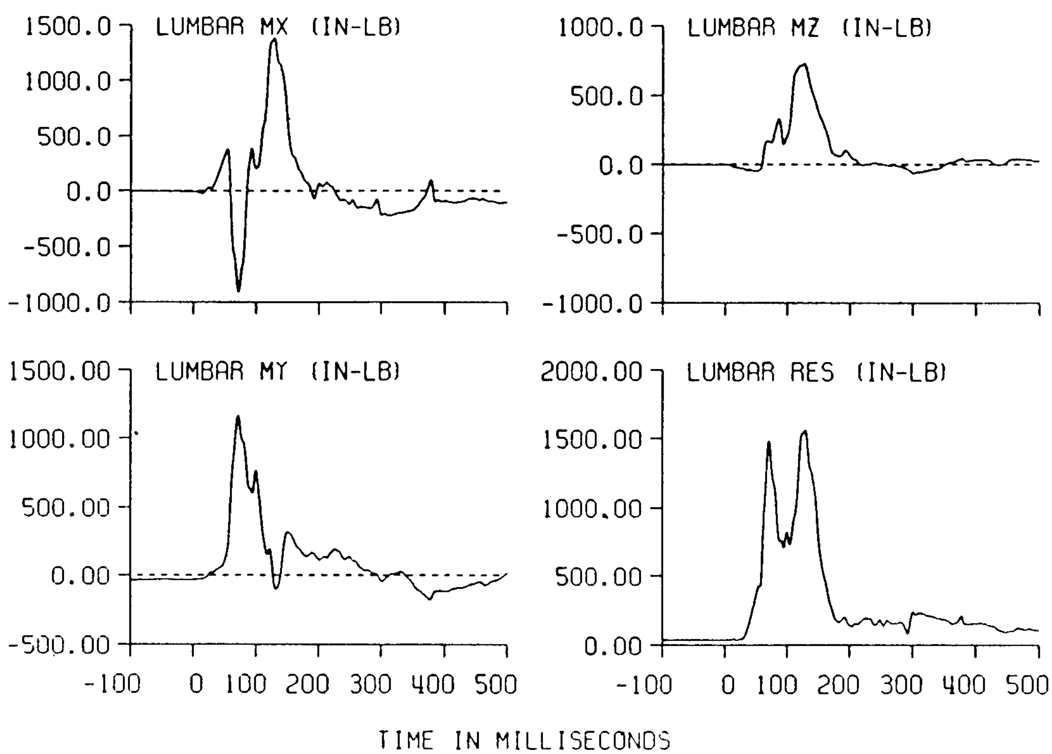
JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



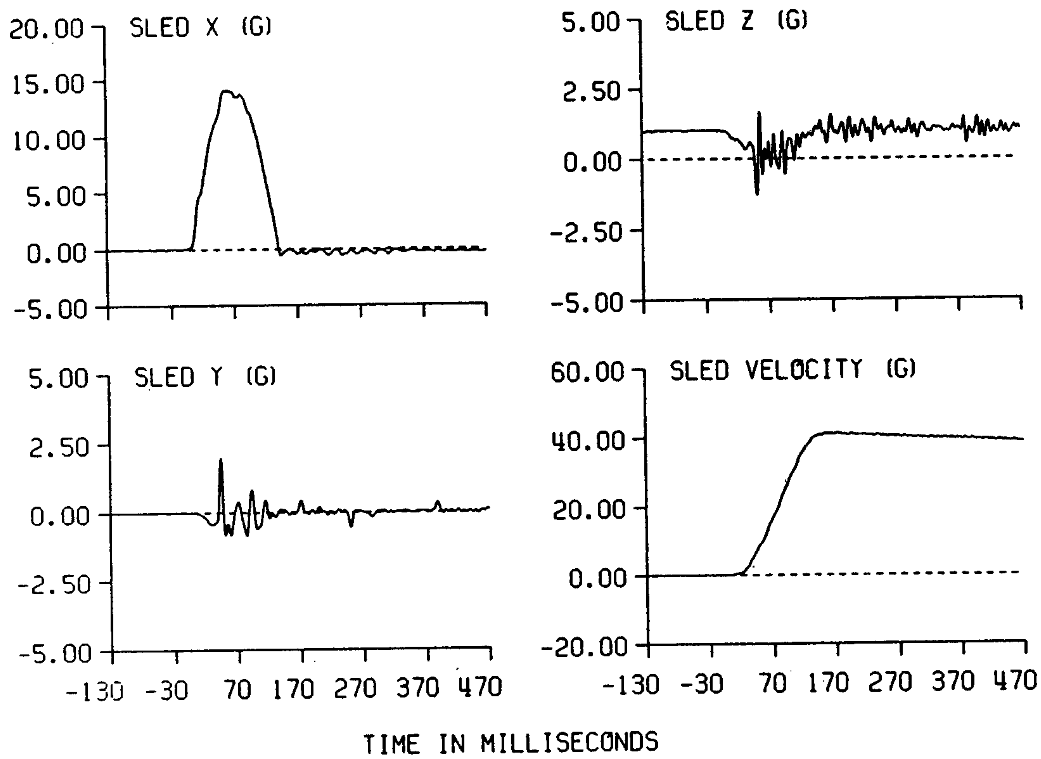
JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



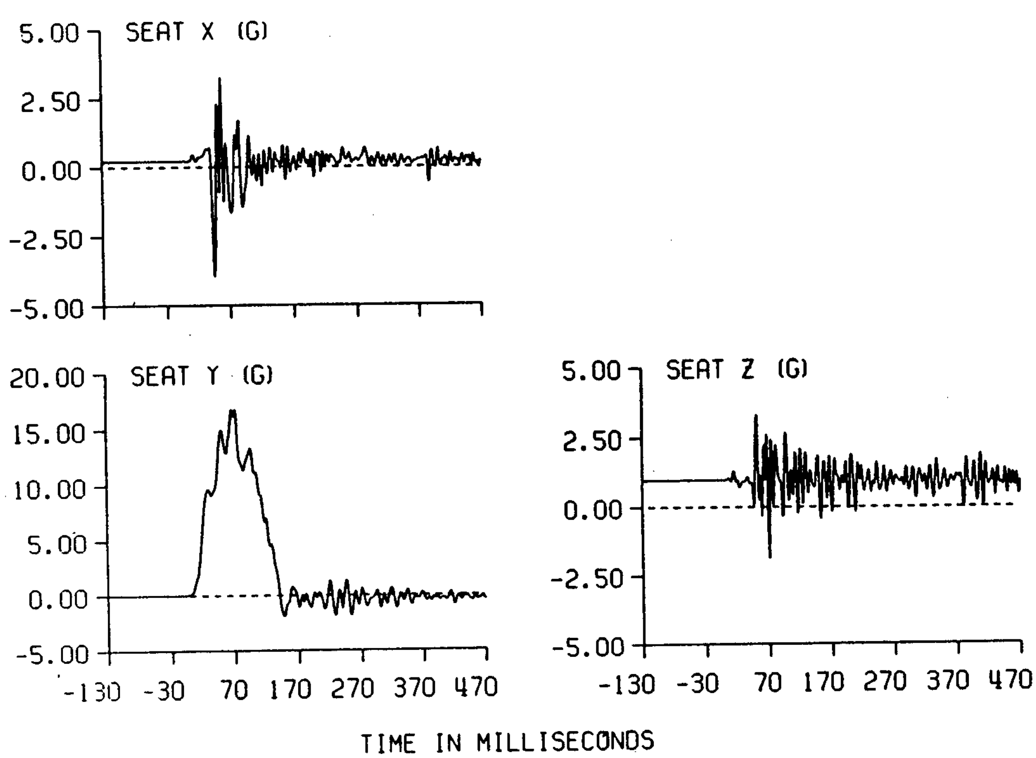
JPATS STUDY TEST: 5246 SUBJ: ADAM-L CELL: H



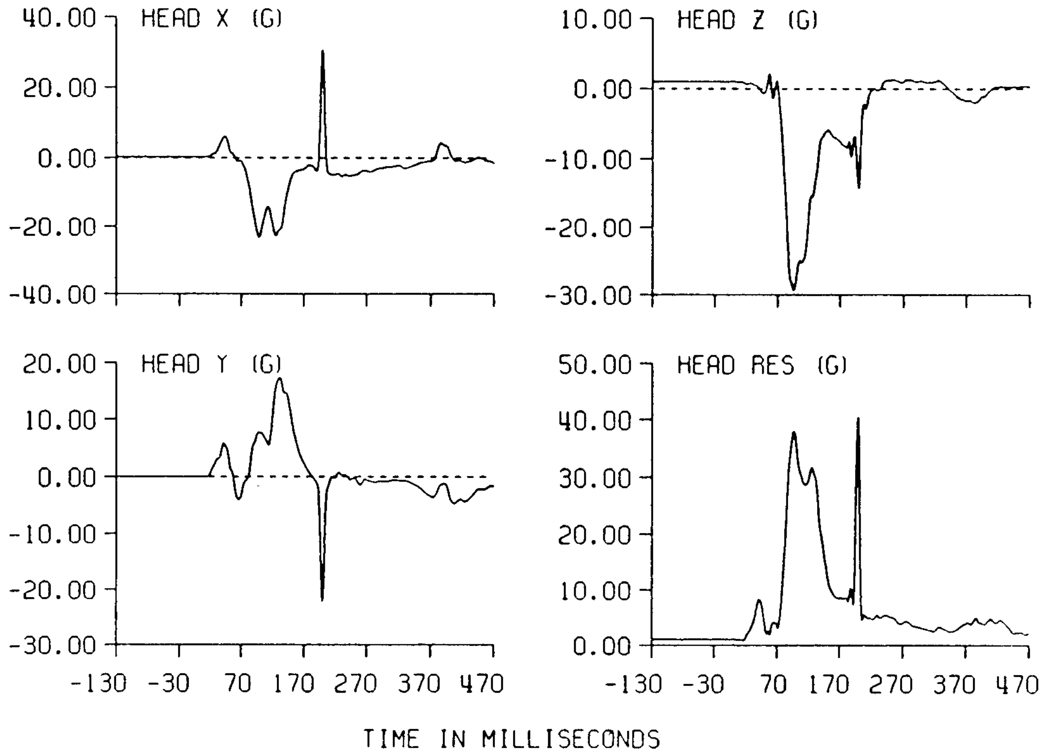
JPATS +GY STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



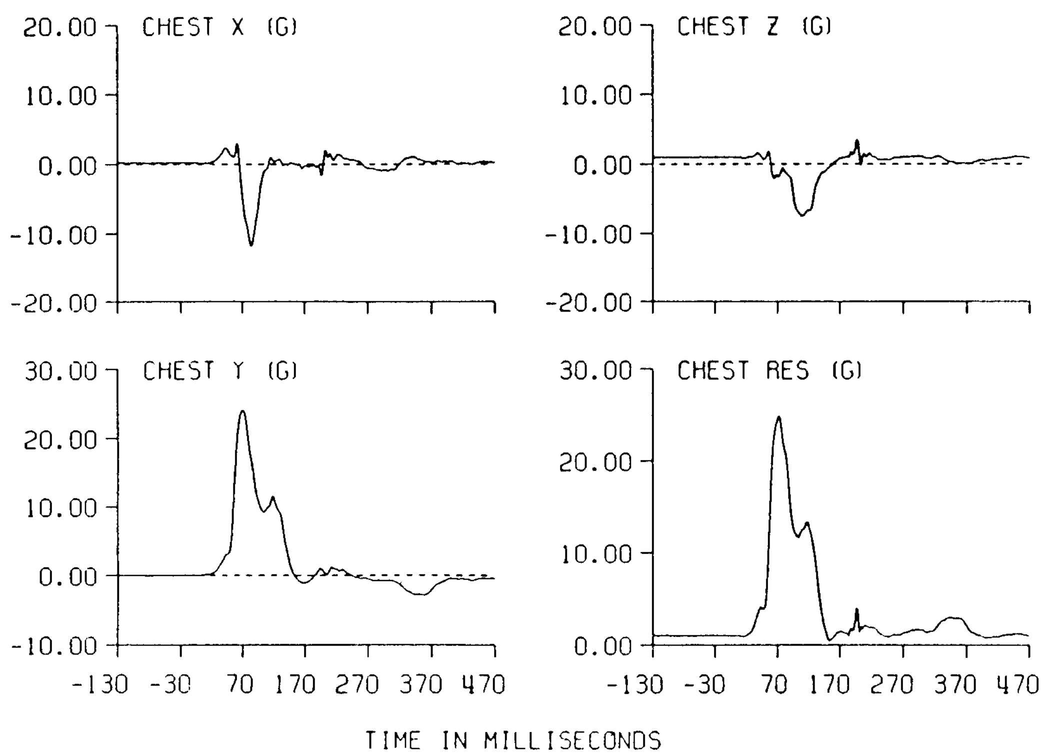
JPATS +GY STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



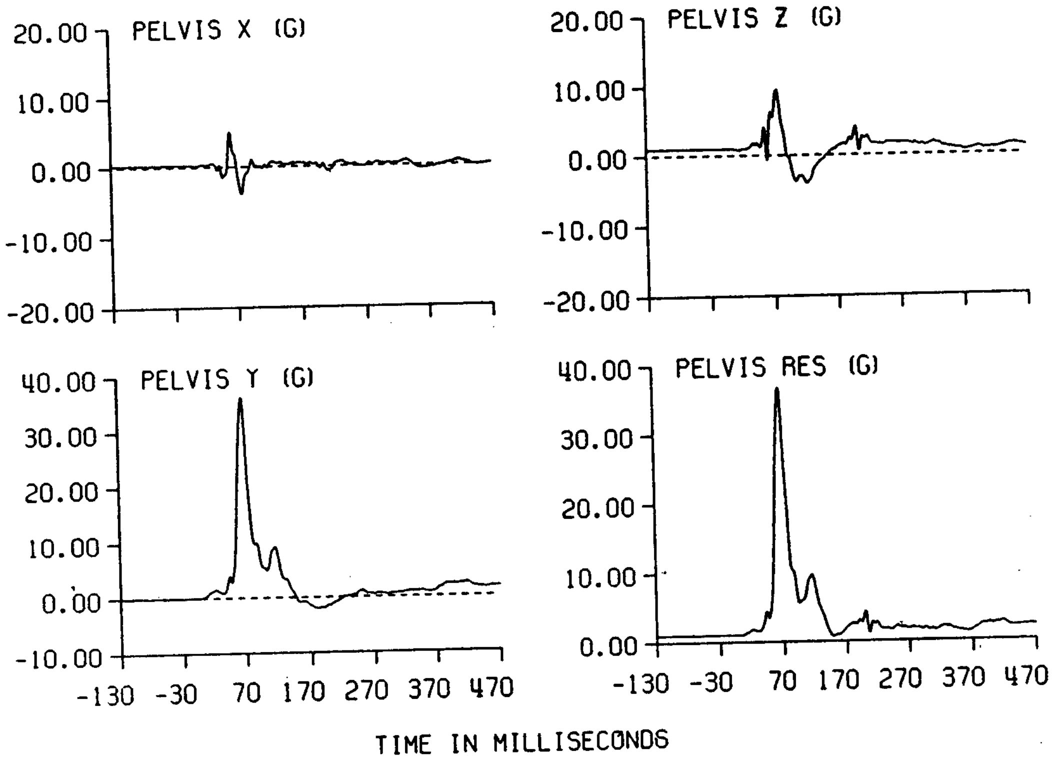
JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



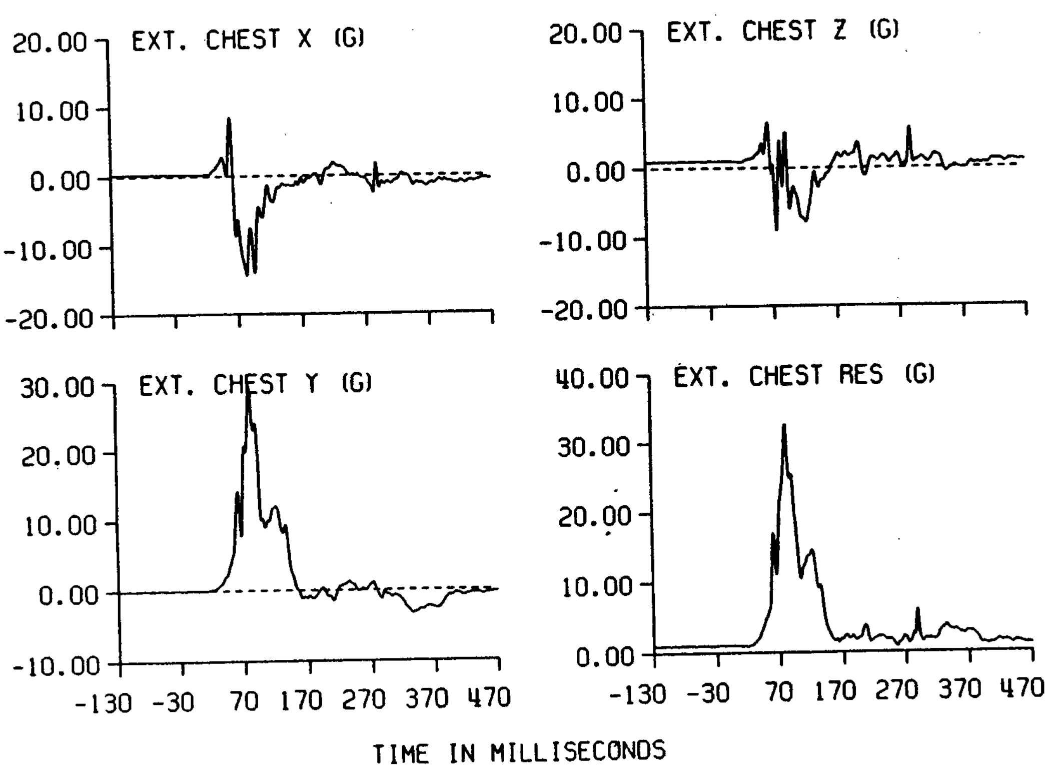
JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



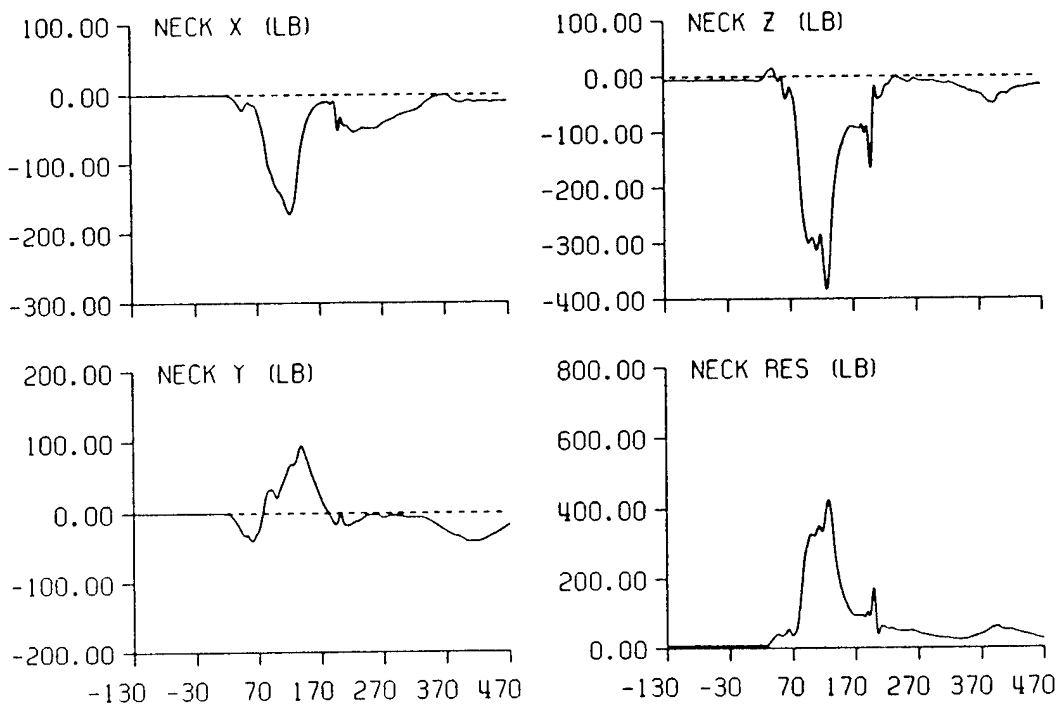
JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



JPATS +GY STUDY TEST: 5257 SUBJ: JPAT-S CELL: I

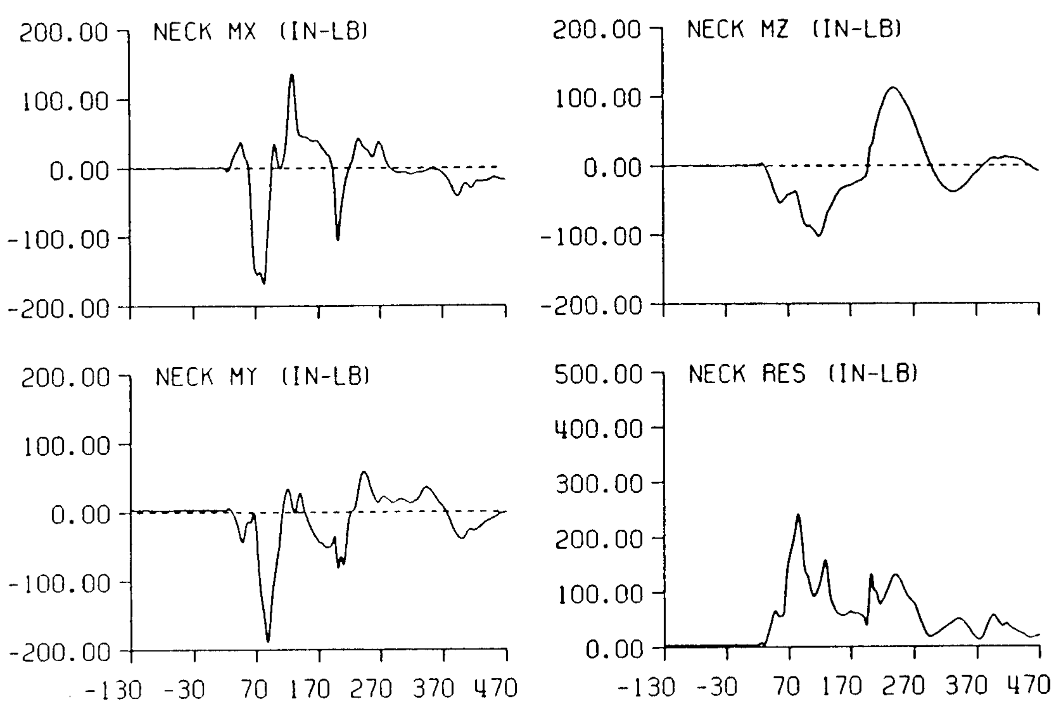


JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



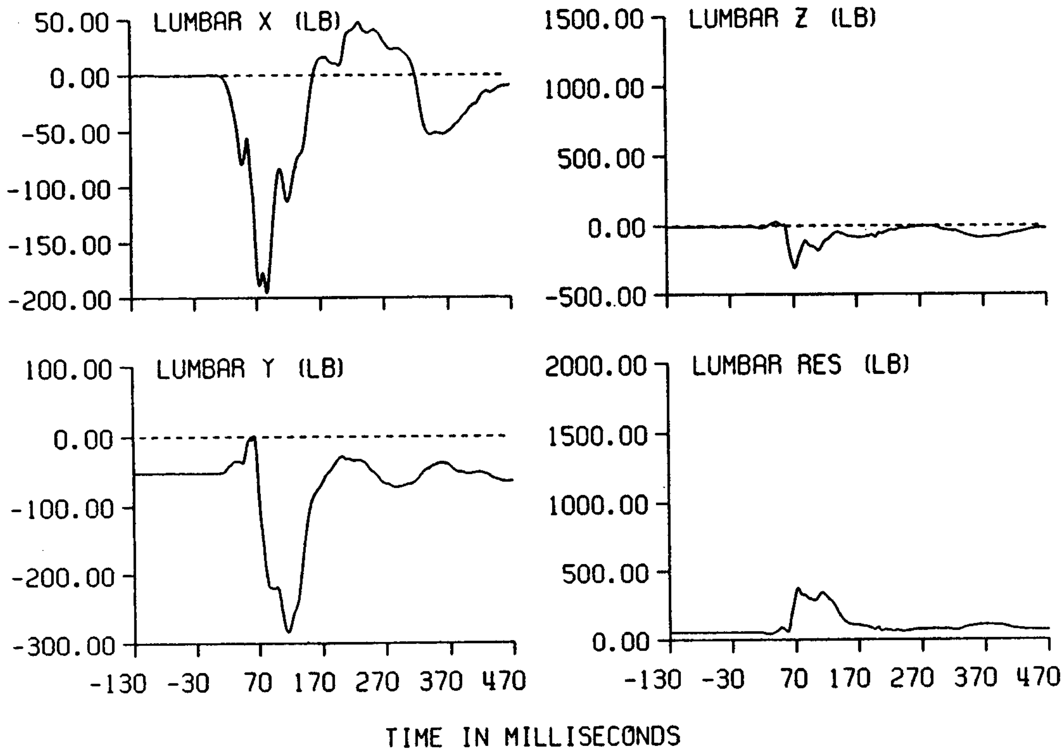
TIME IN MILLISECONDS

JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I

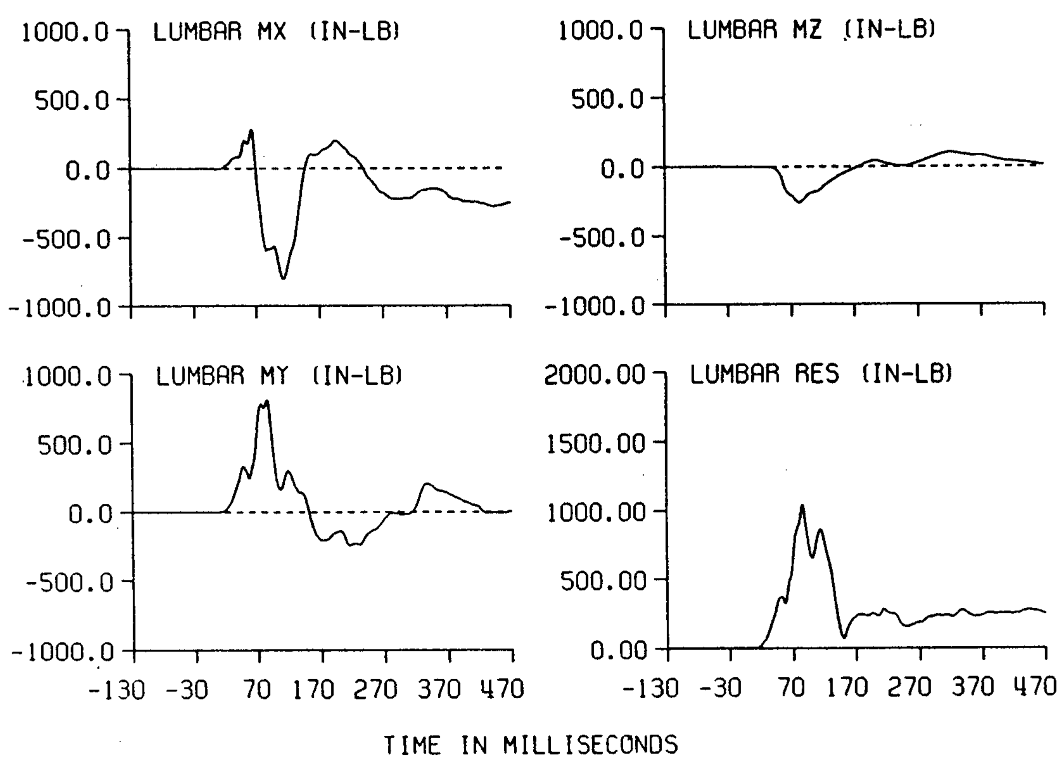


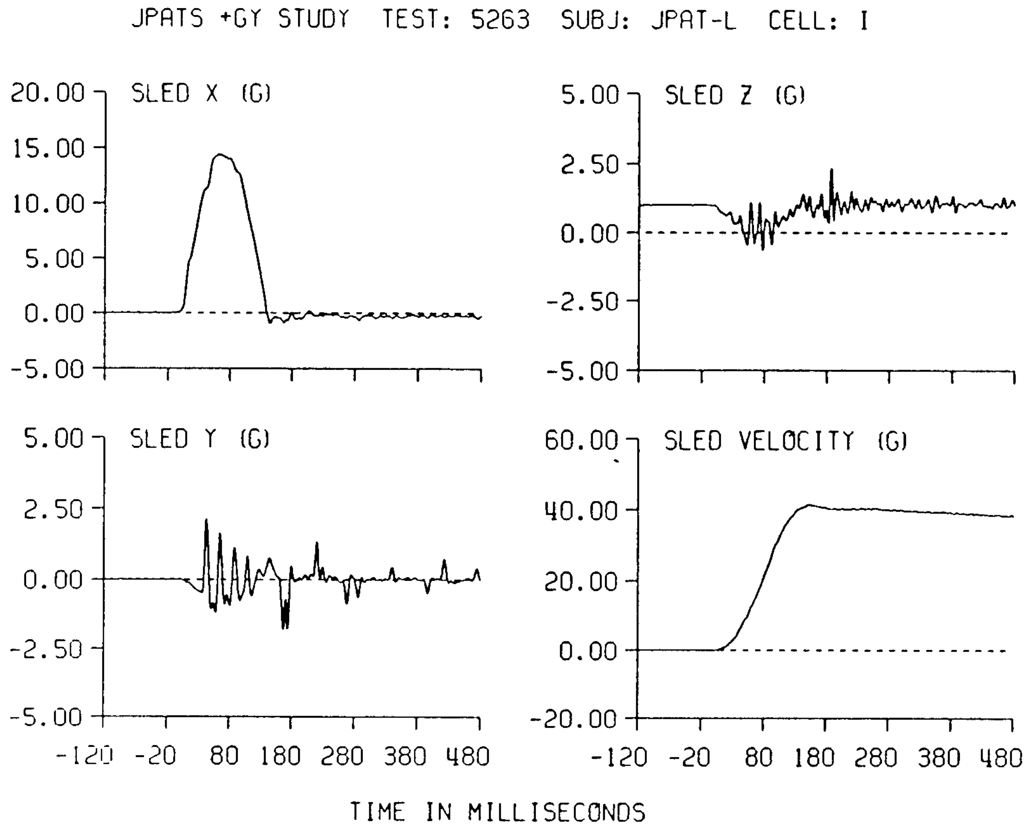
TIME IN MILLISECONDS

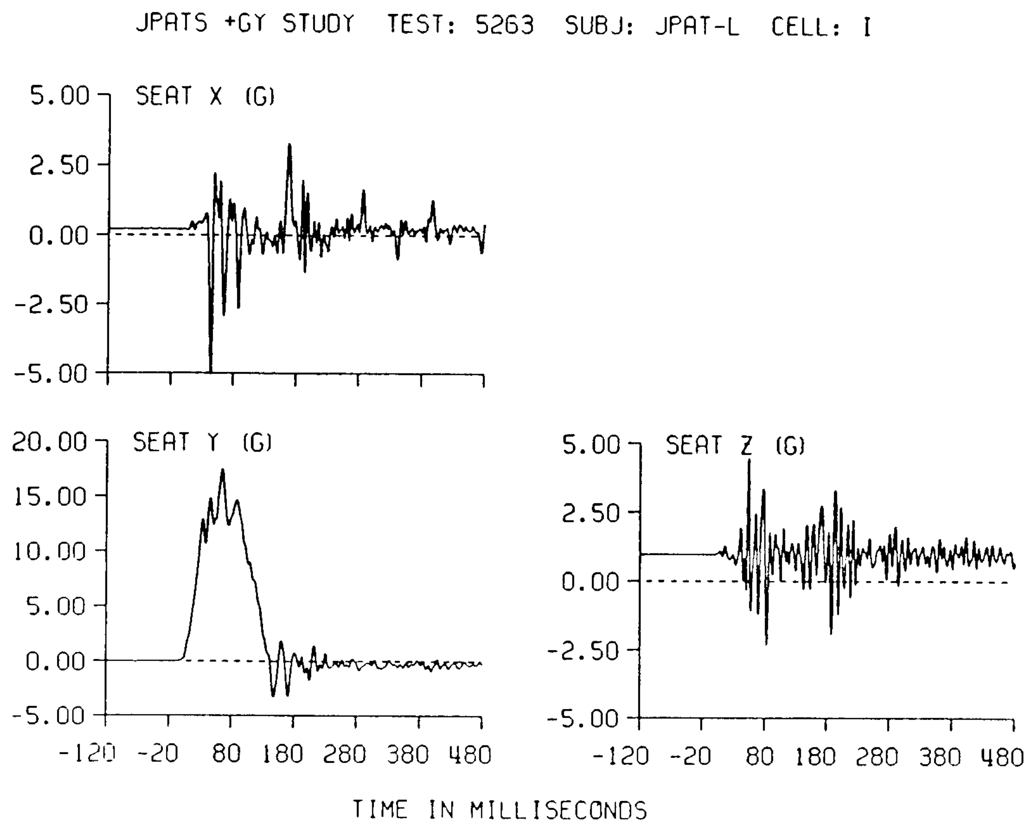
JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I



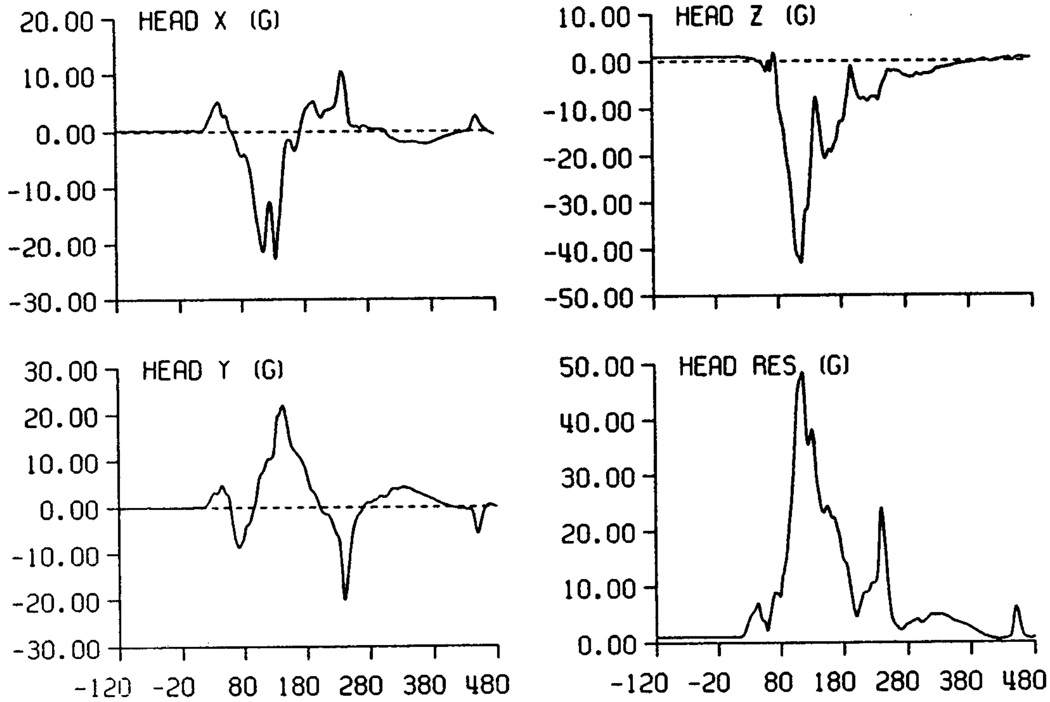
JPATS STUDY TEST: 5257 SUBJ: JPAT-S CELL: I




JPATS +GY STUDY TEST: 5263 SUBJ: JPAT-L CELL: I
SLED X (G)
SLED Z (G)
SLED Y (G)
SLED VELOCITY (G)
TIME IN MILLISECONDS

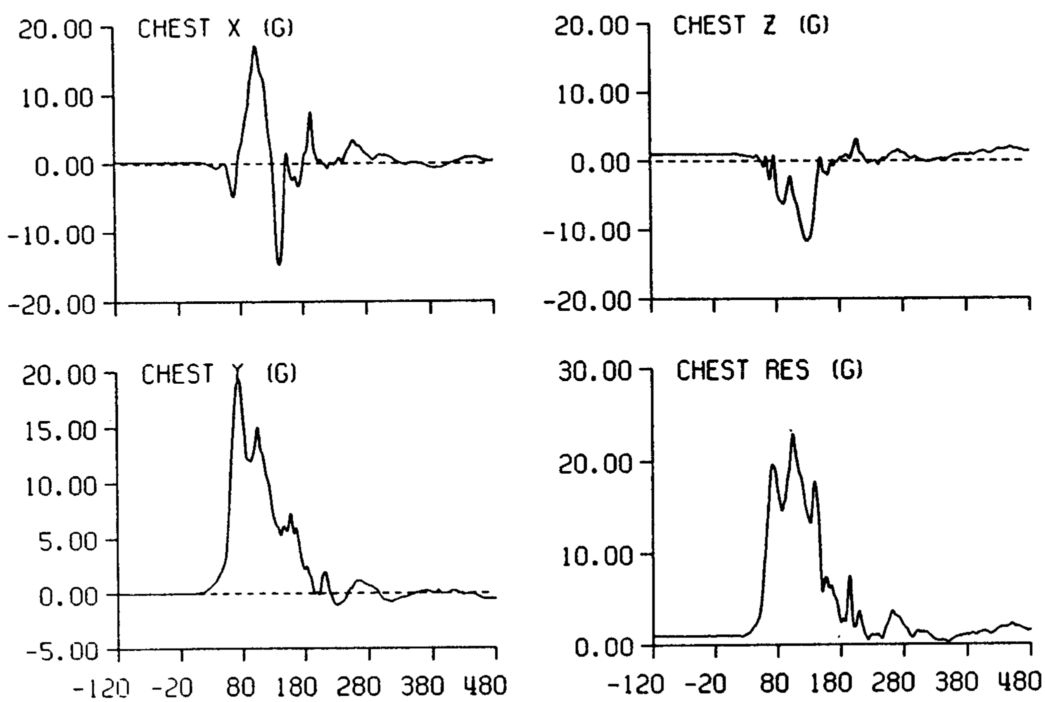

JPATS +GY STUDY TEST: 5263 SUBJ: JPAT-L CELL: I
SEAT X (G)
SEAT Y (G)
SEAT Z (G)
TIME IN MILLISECONDS

JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I



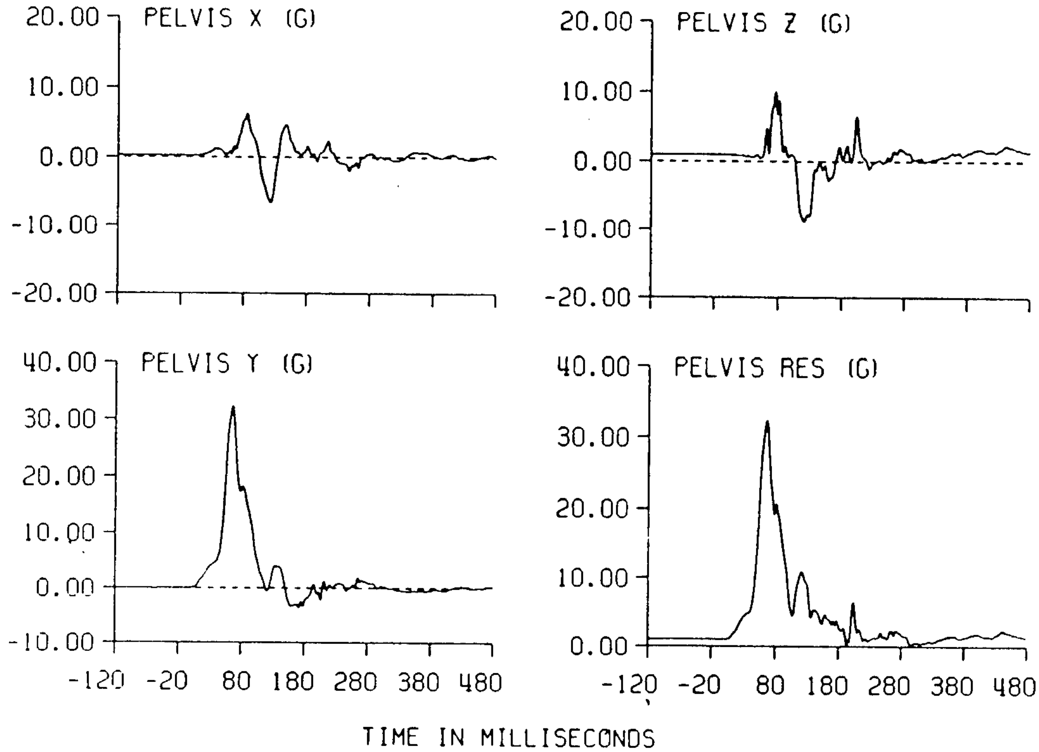
TIME IN MILLISECONDS

JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I

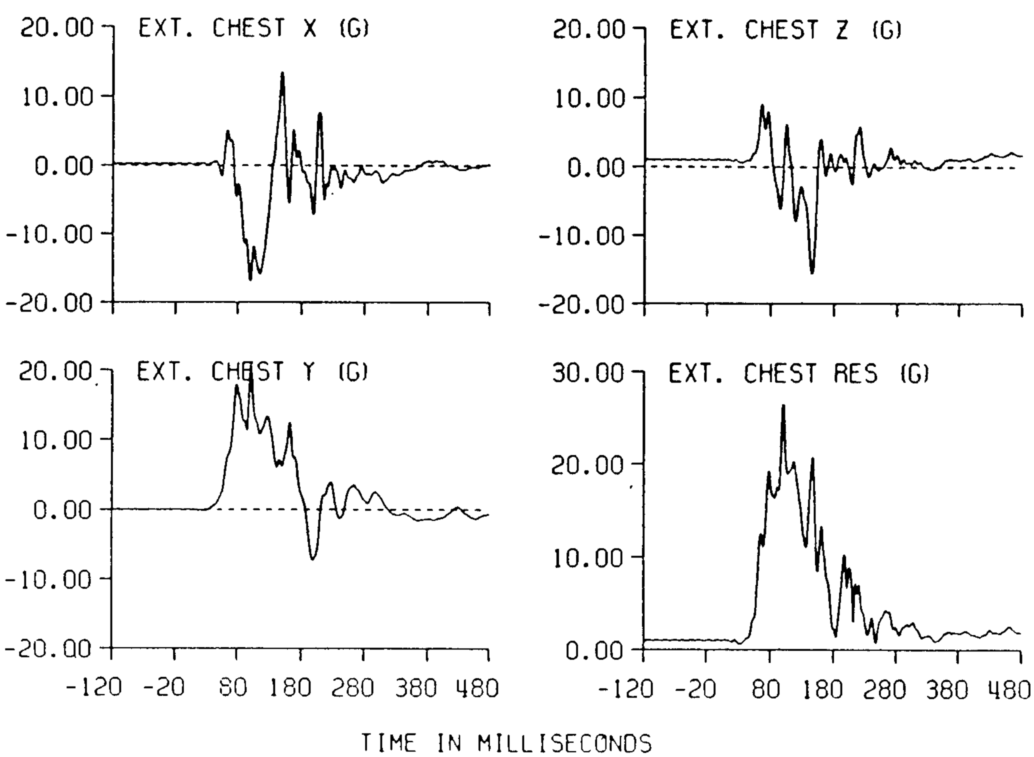


TIME IN MILLISECONDS

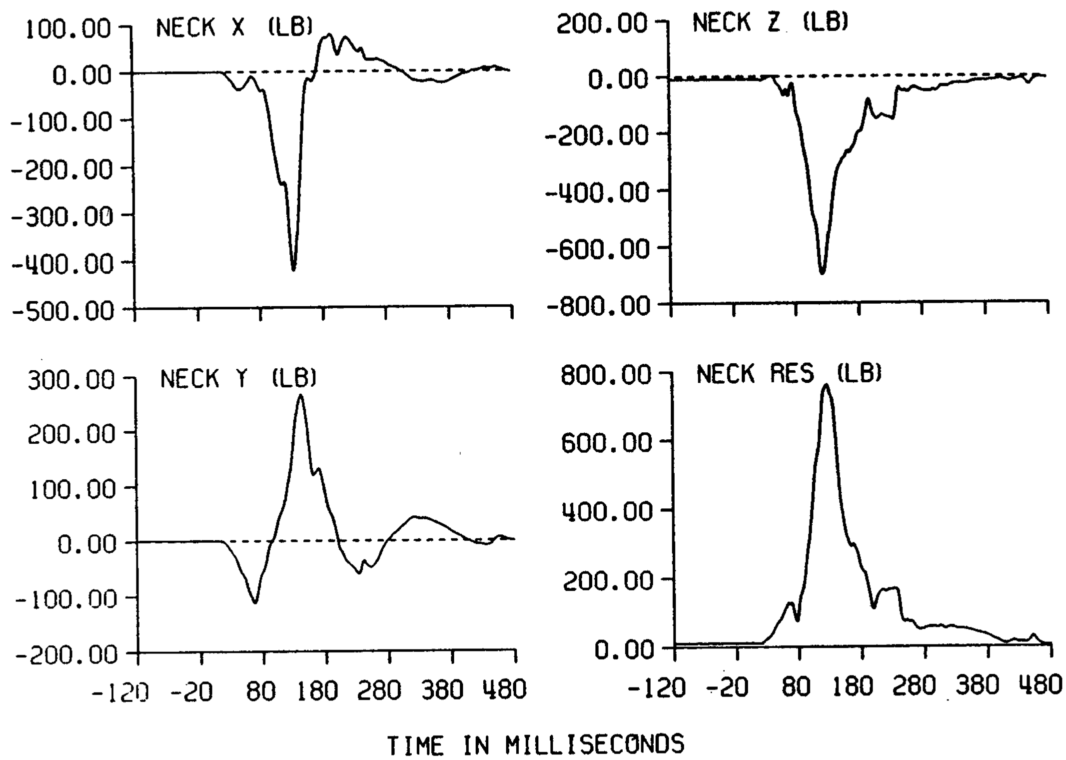
JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I



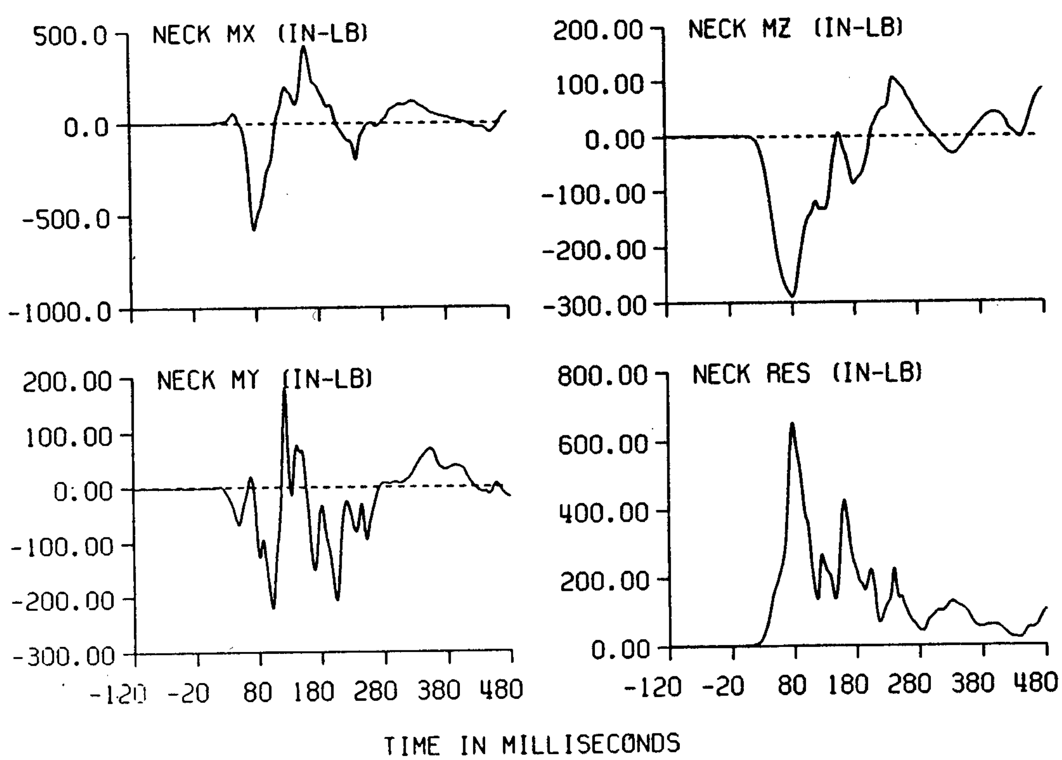
JPATS +GY STUDY TEST: 5263 SUBJ: ADAM-L CELL: I



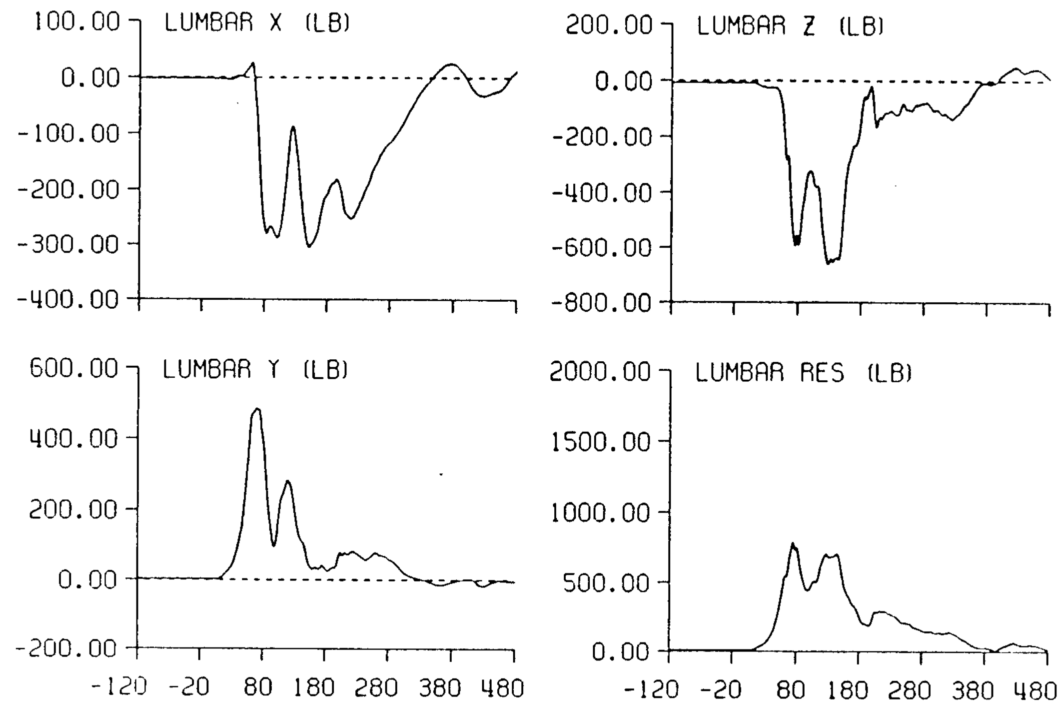
JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I



JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I

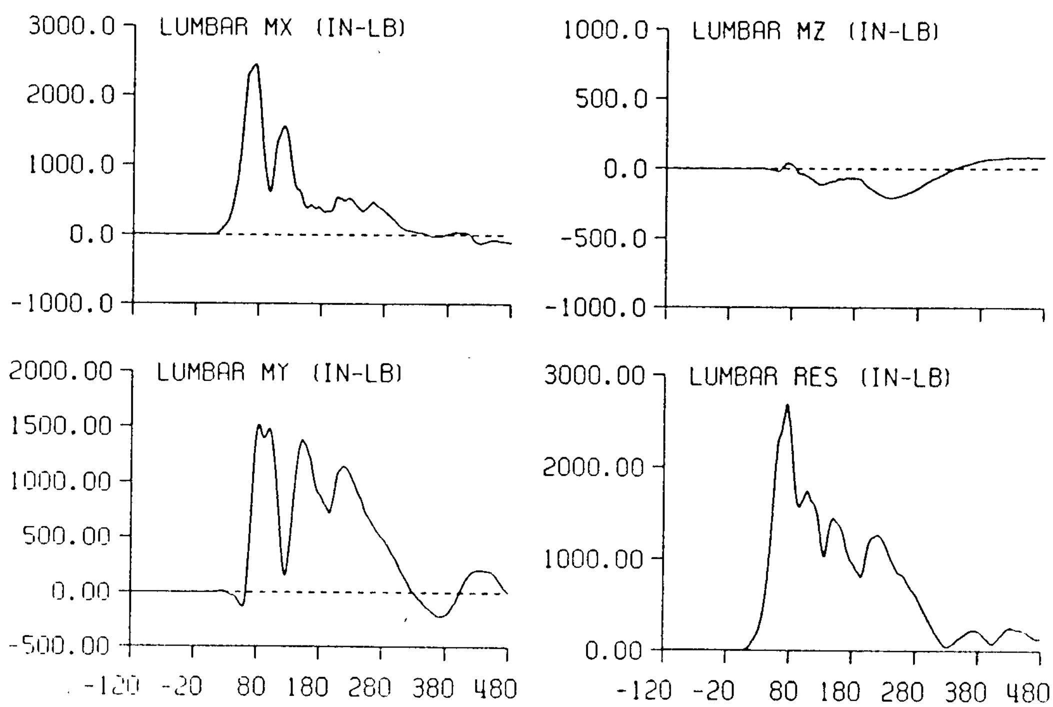


JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I



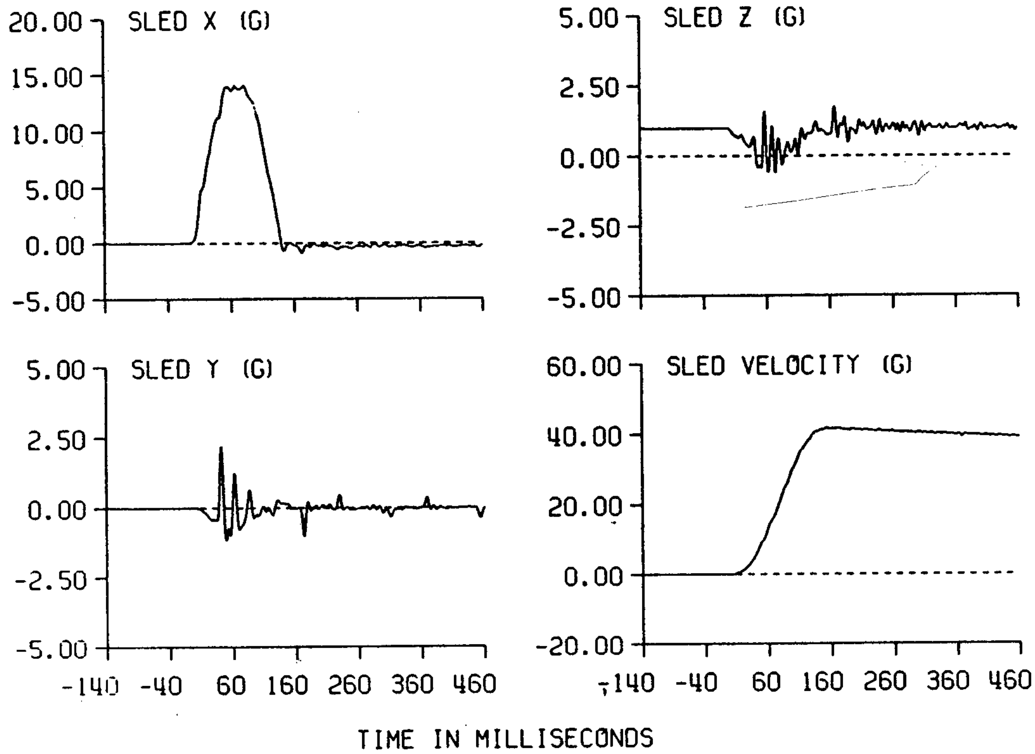
TIME IN MILLISECONDS

JPATS STUDY TEST: 5263 SUBJ: JPAT-L CELL: I

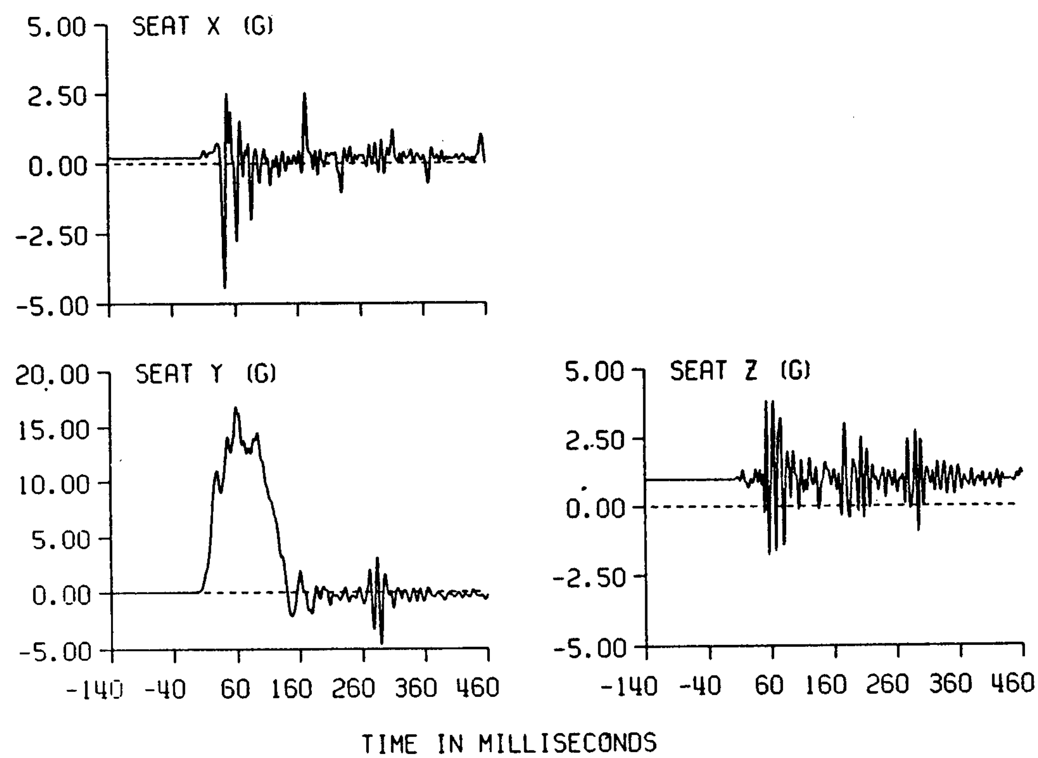


TIME IN MILLISECONDS

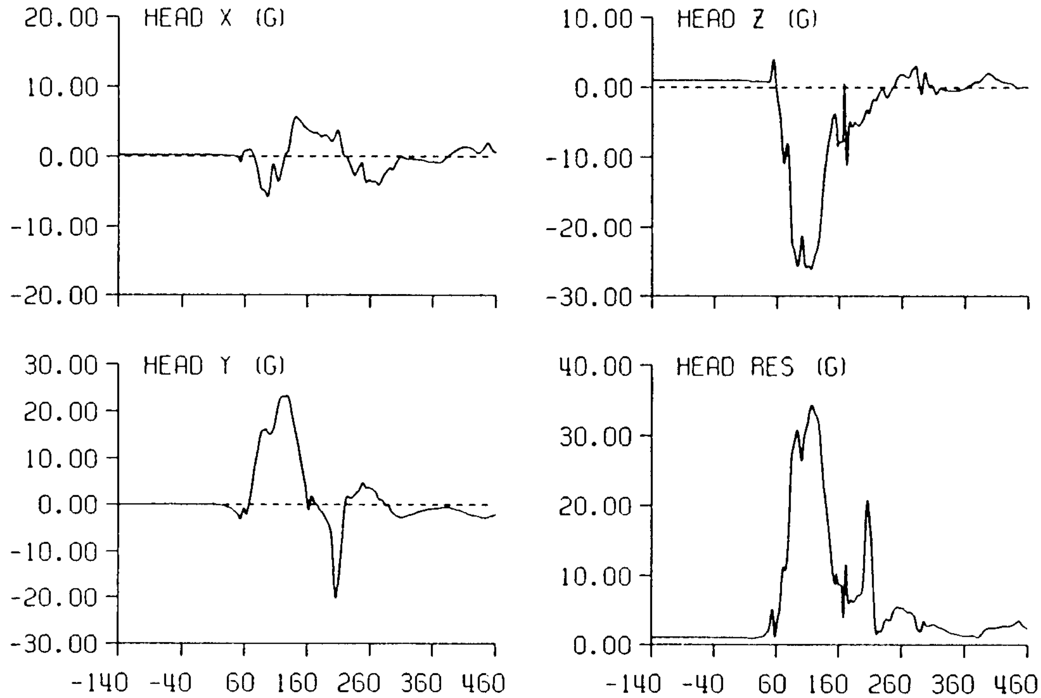
JPATS +GY STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



JPATS +GY STUDY TEST: 5262 SUBJ: ADAM-L CELL: I

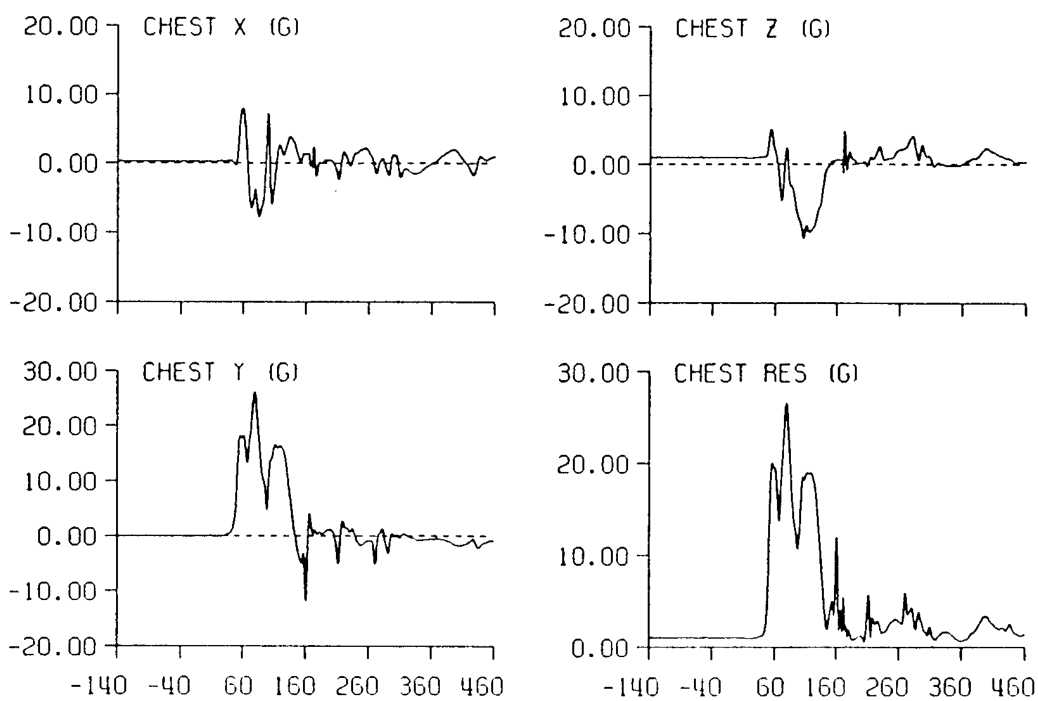


JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



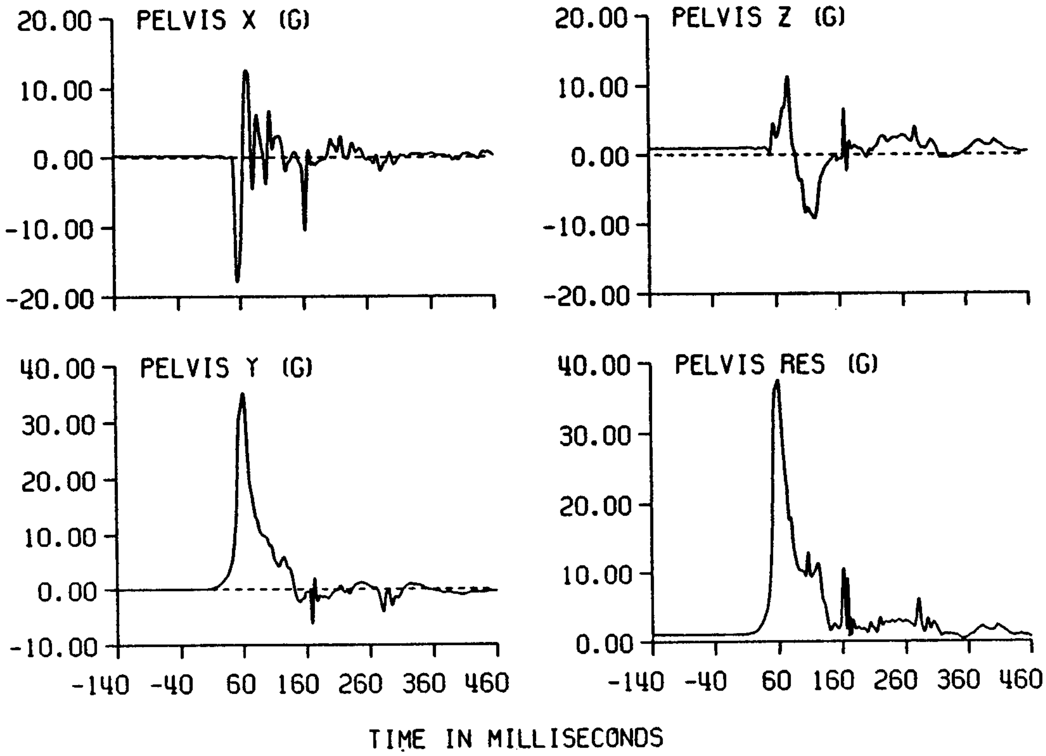
TIME IN MILLISECONDS

JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I

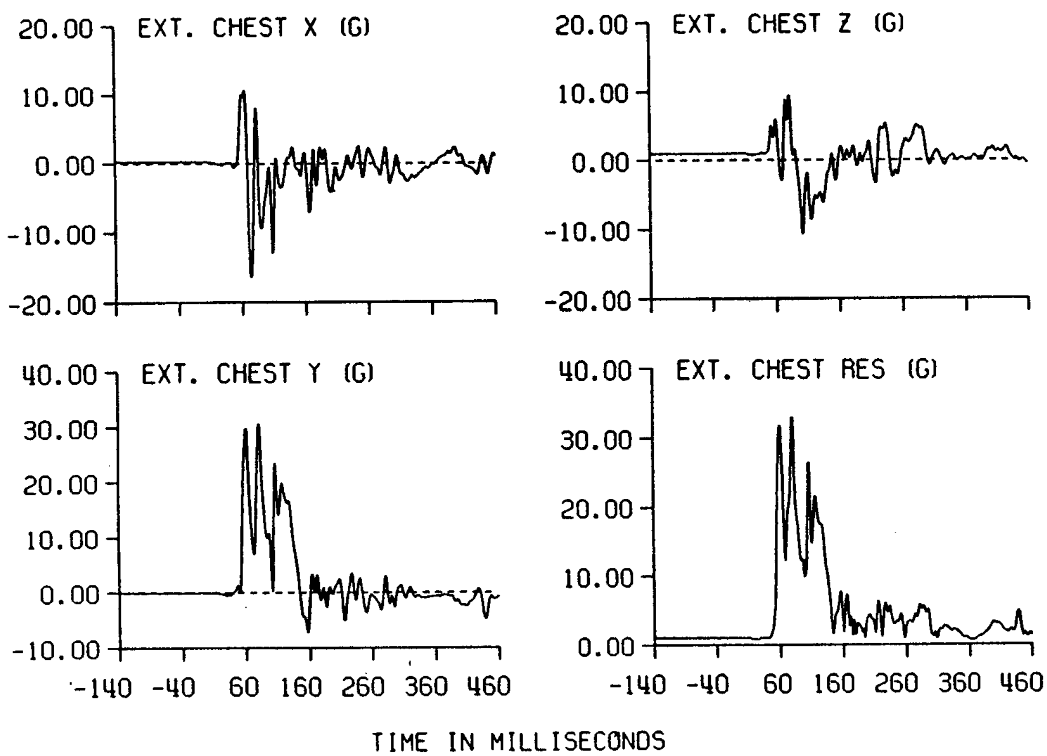


TIME IN MILLISECONDS

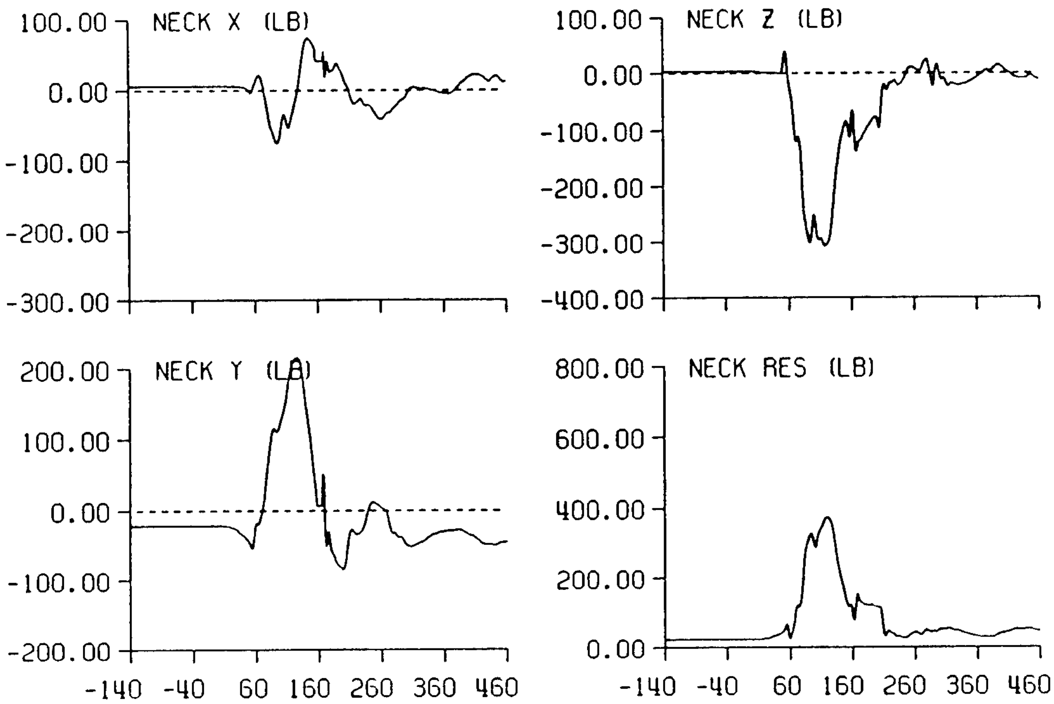
JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



JPATS +GY STUDY TEST: 5262 SUBJ: ADAM-L CELL: I

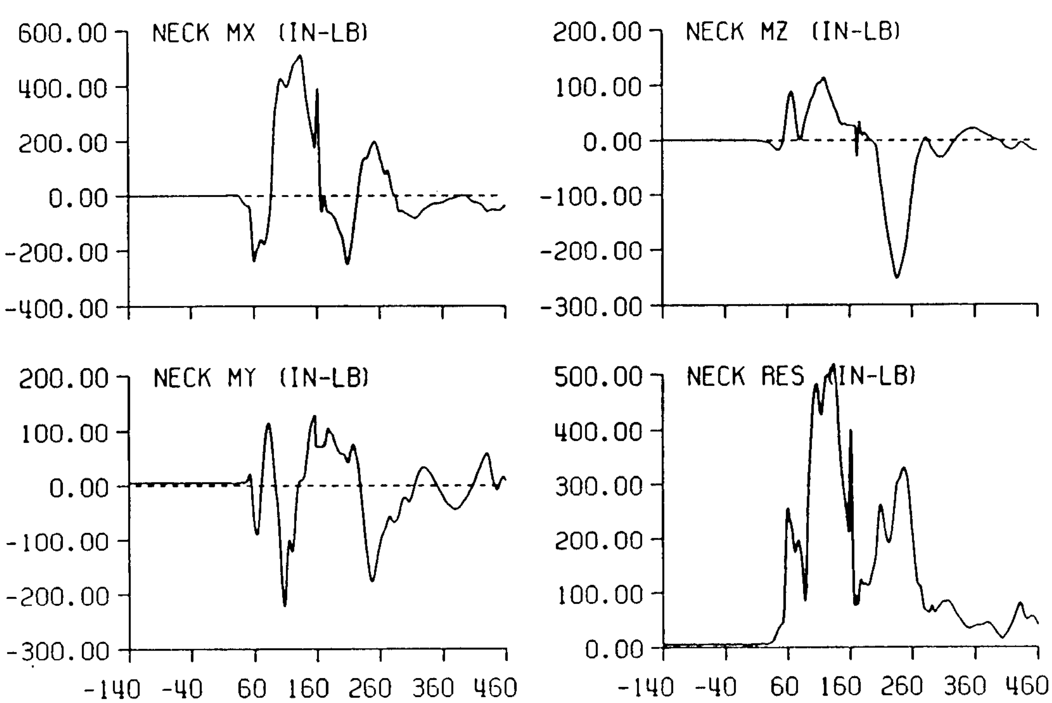


JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



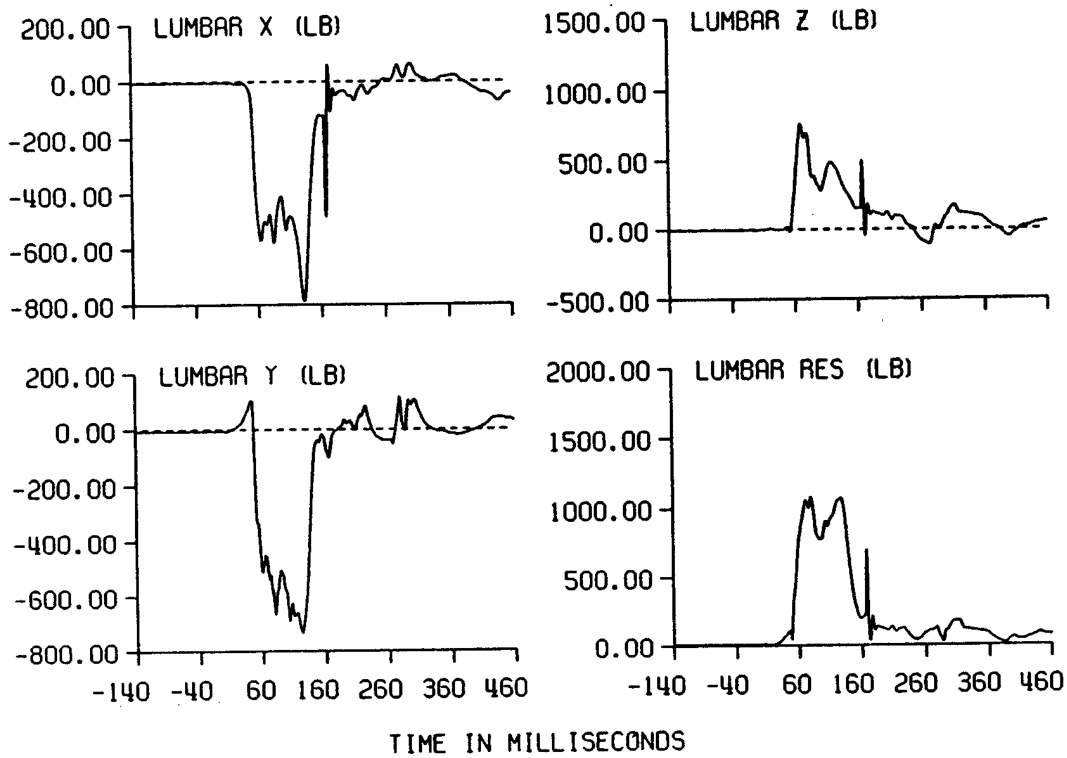
TIME IN MILLISECONDS

JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I

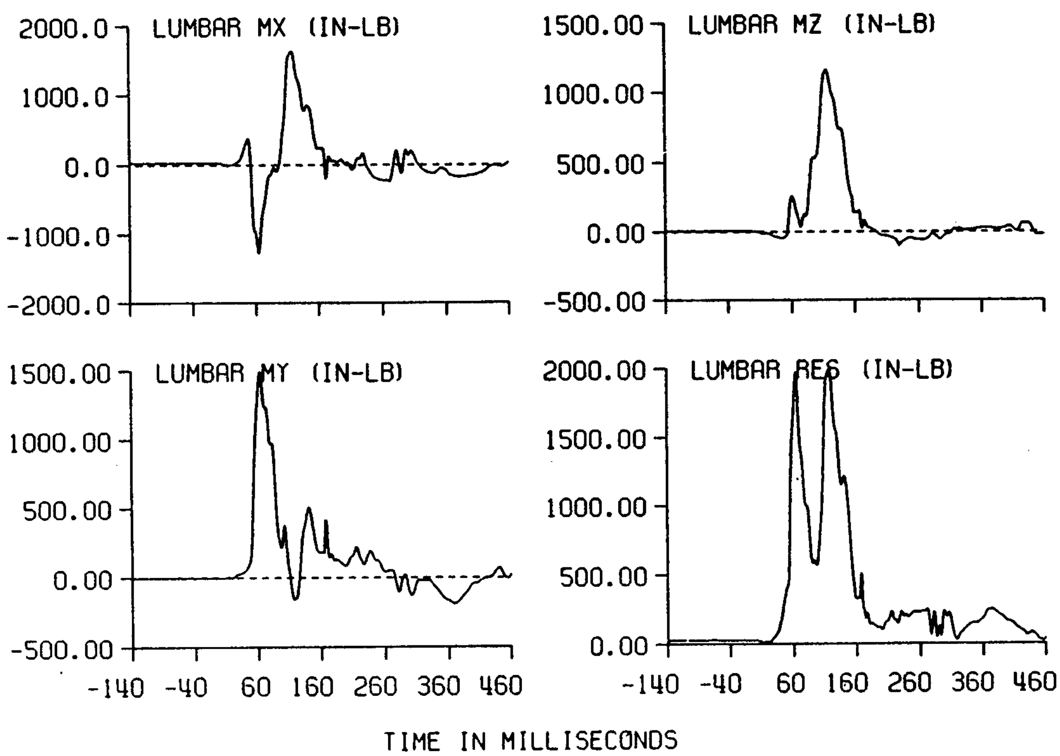


TIME IN MILLISECONDS

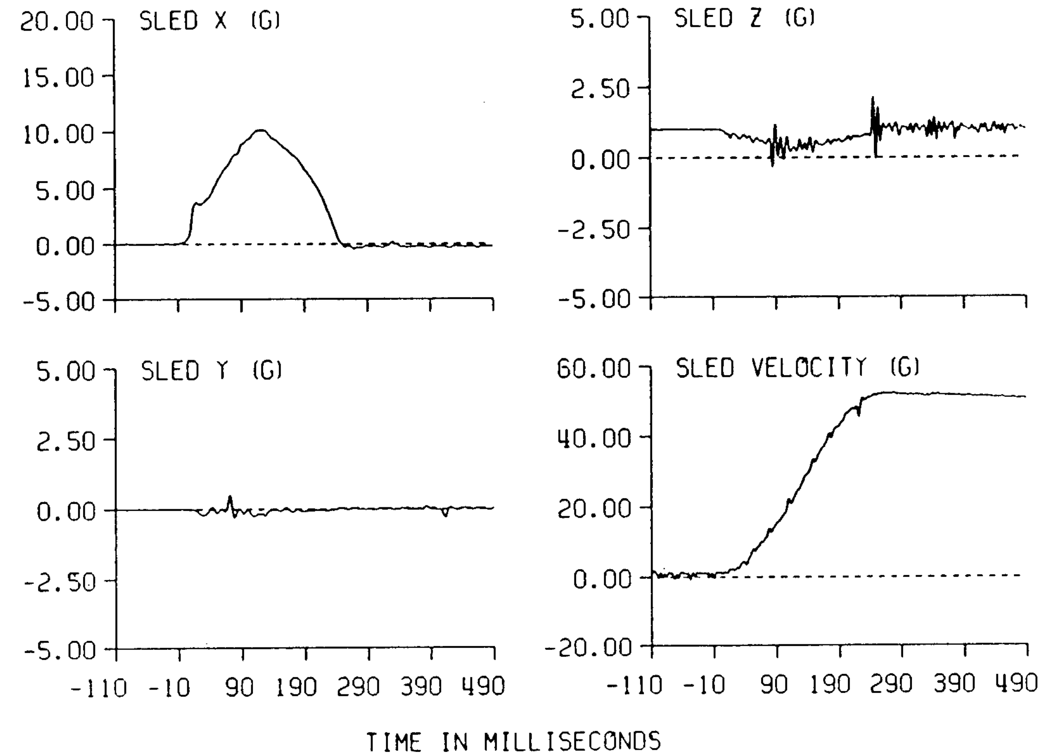
JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



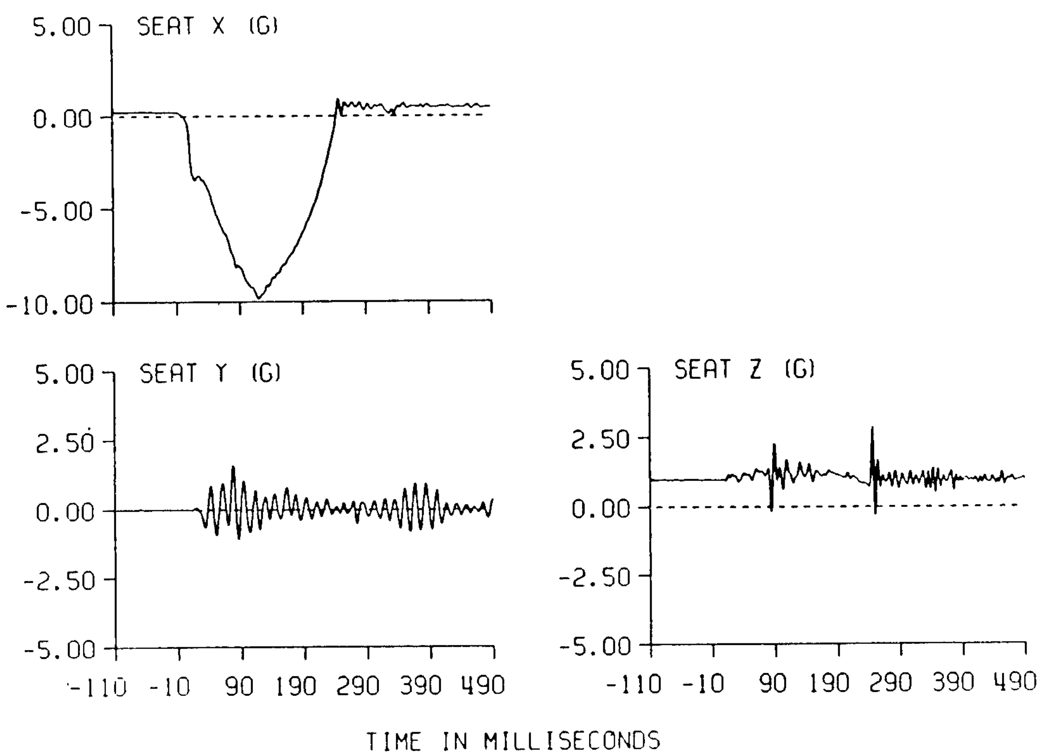
JPATS STUDY TEST: 5262 SUBJ: ADAM-L CELL: I



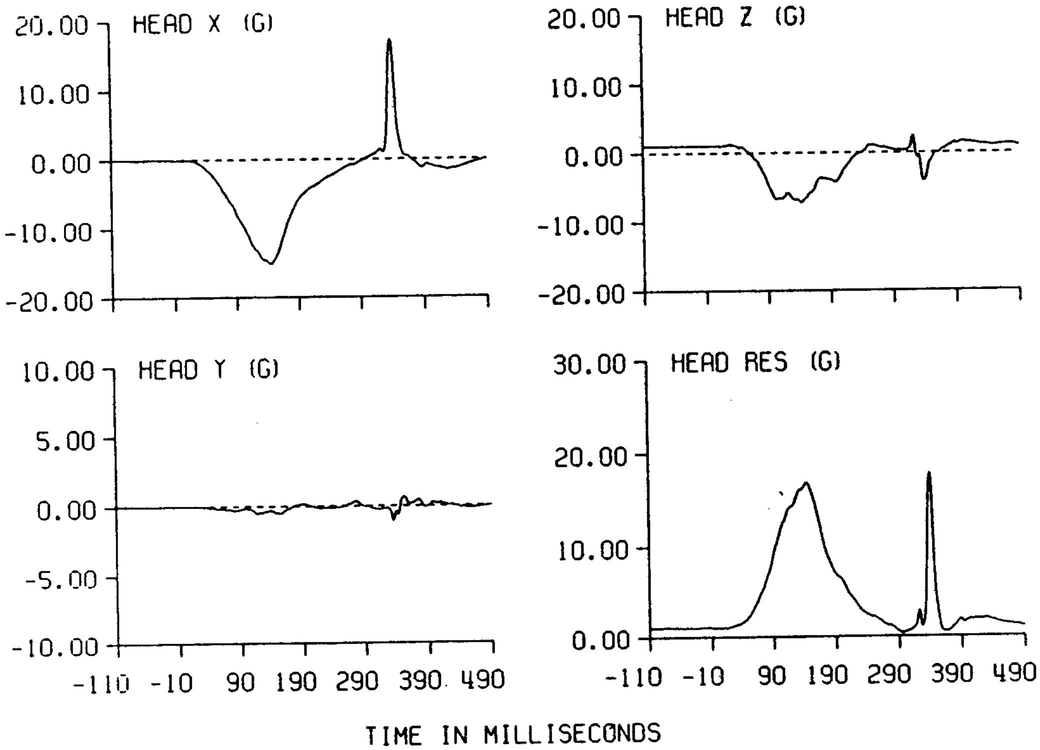
JPATS -GX STUDY TEST: 5278 SUBJ: JPAT-S CELL: J



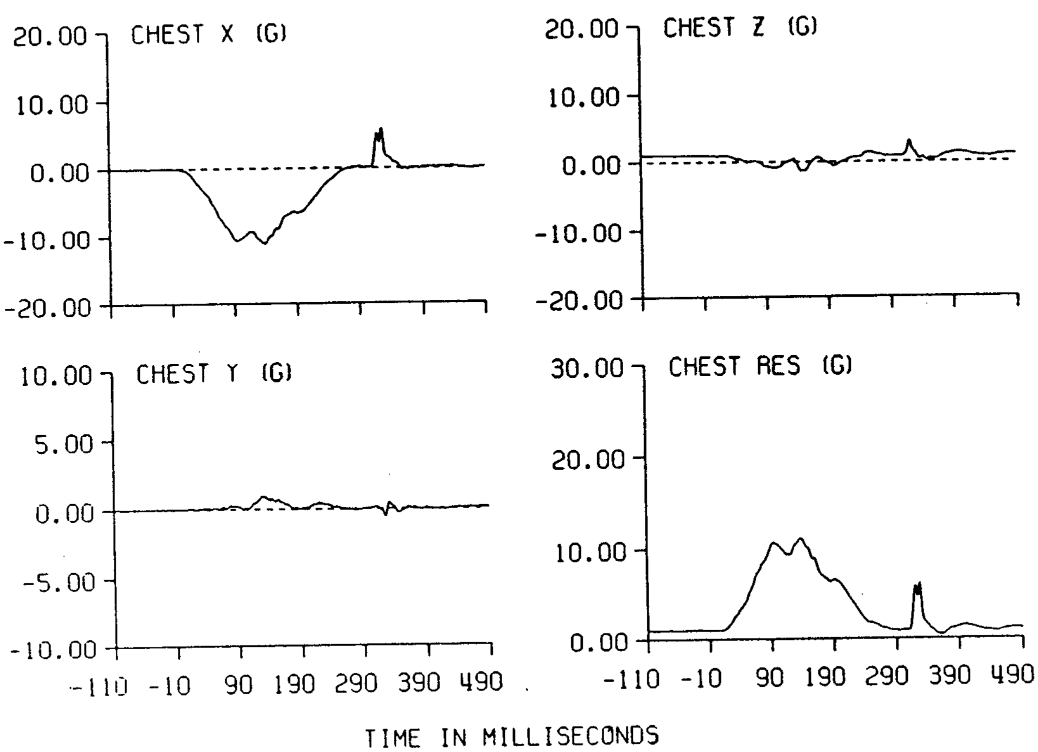
JPATS -GX STUDY TEST: 5278 SUBJ: JPAT-S CELL: J



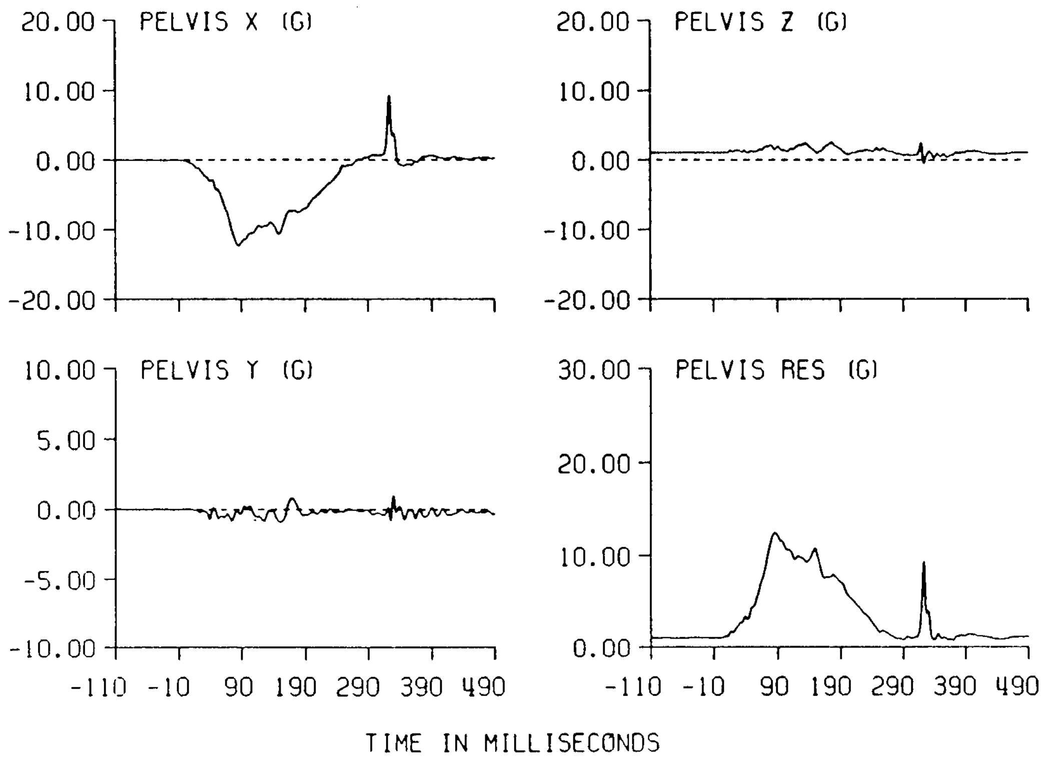
JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J



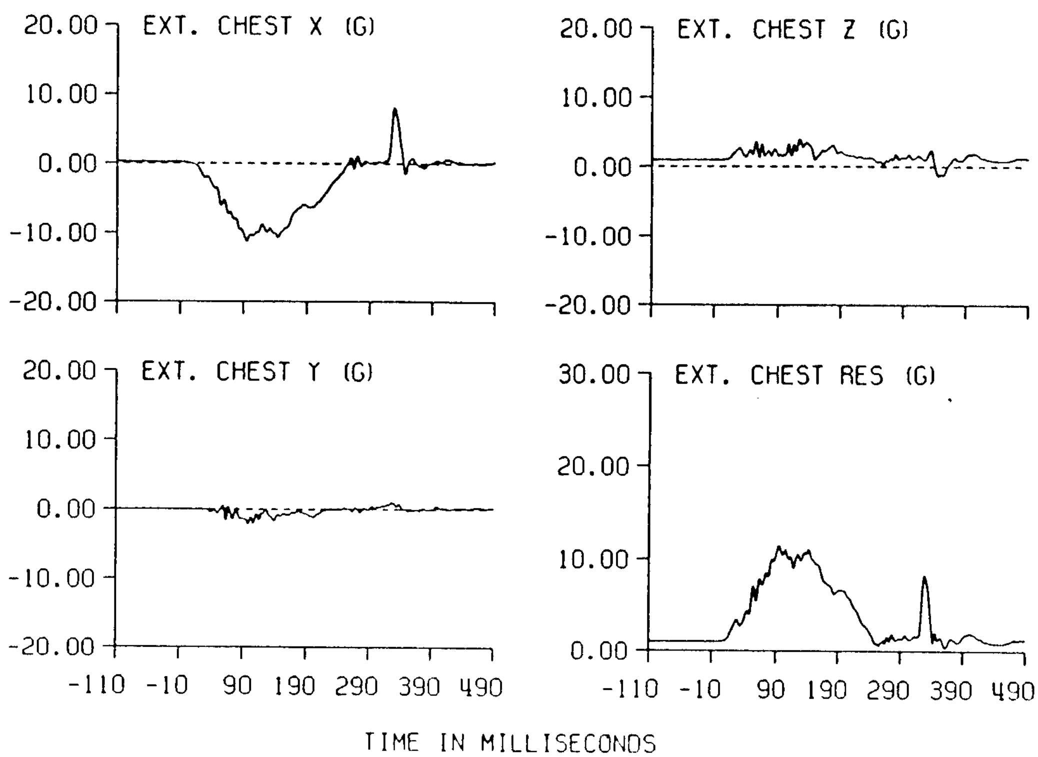
JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J

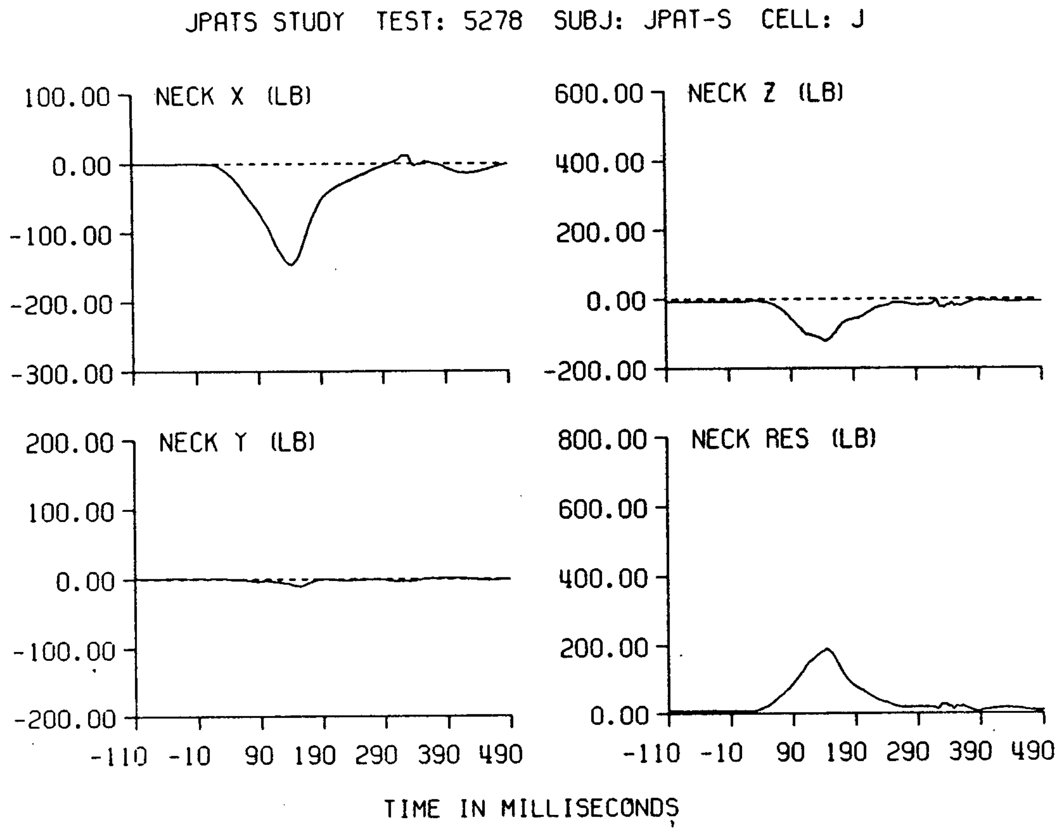


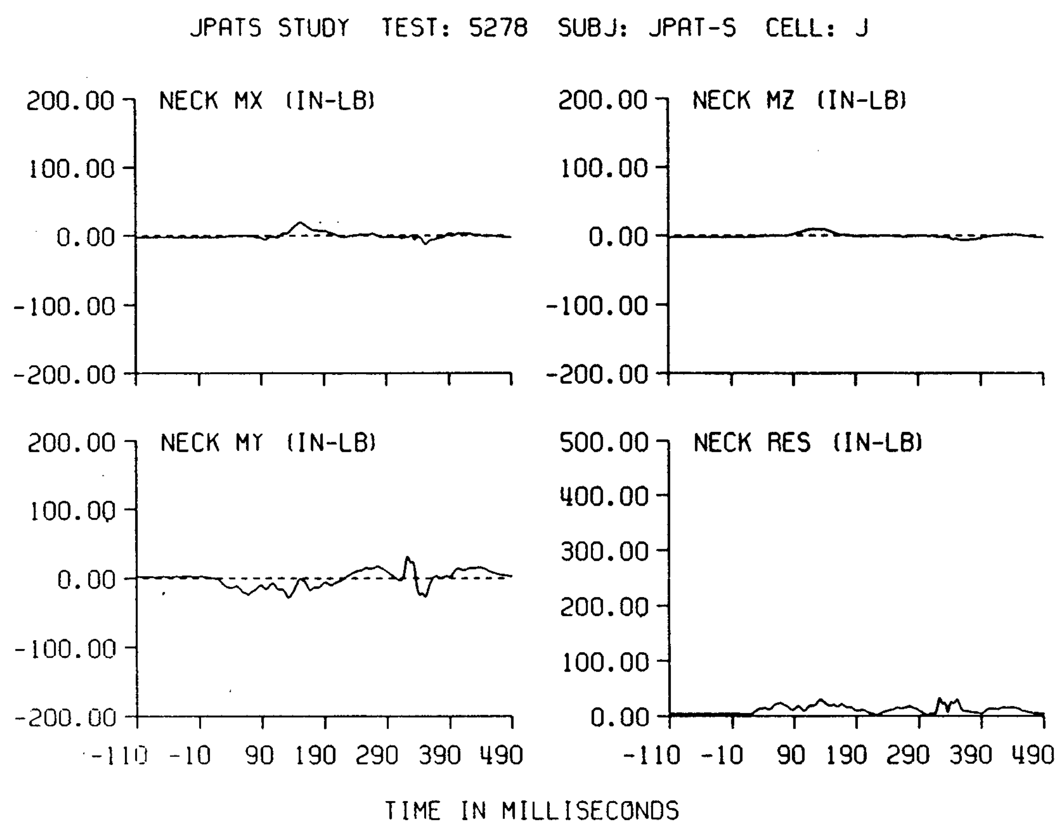
JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J

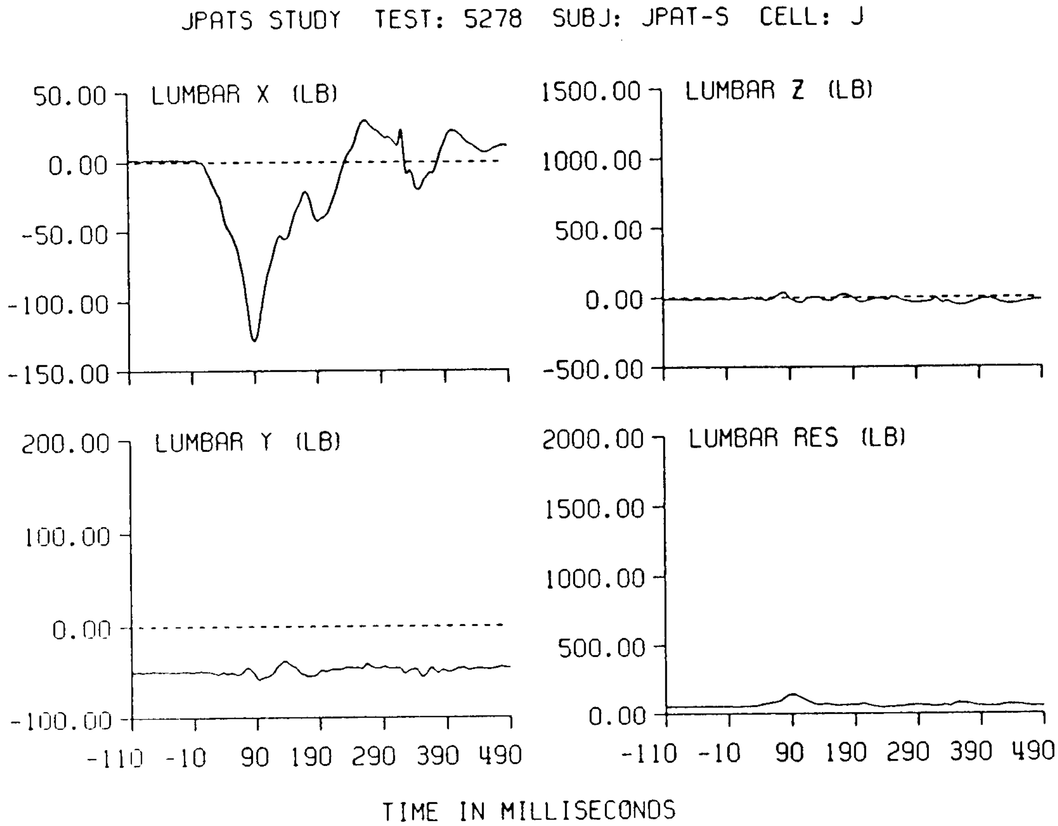


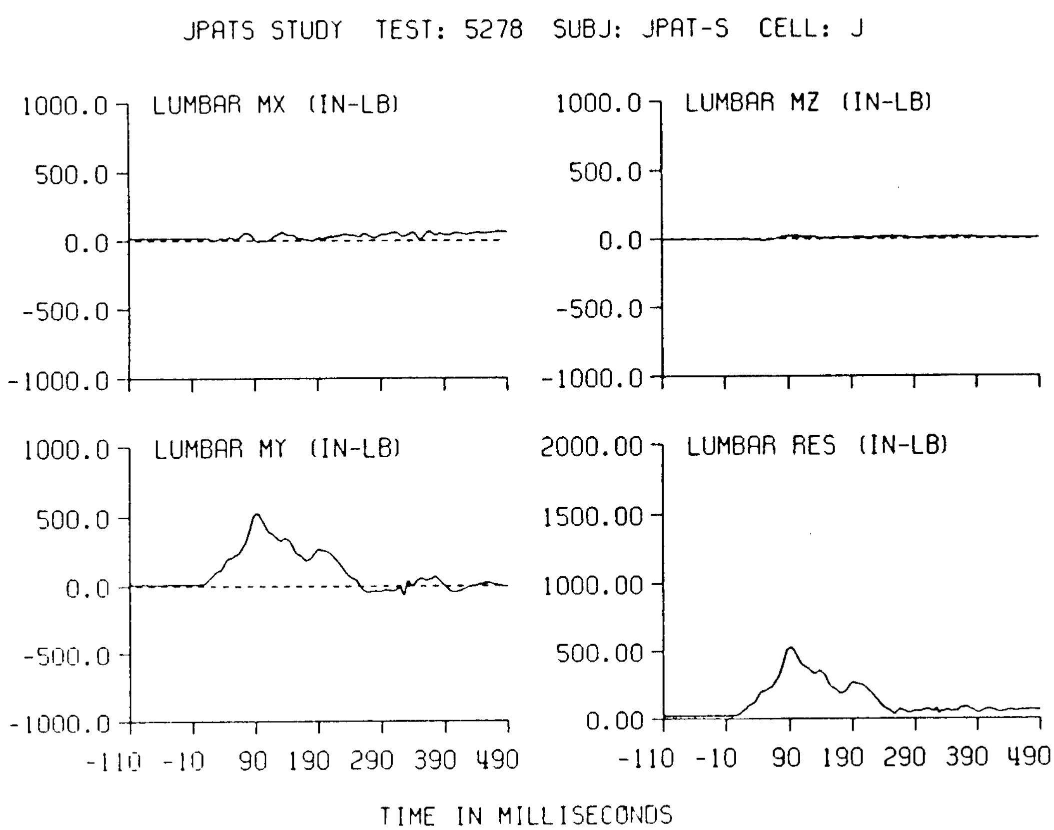
JPATS -GX STUDY TEST: 5278 SUBJ: JPAT-S CELL: J



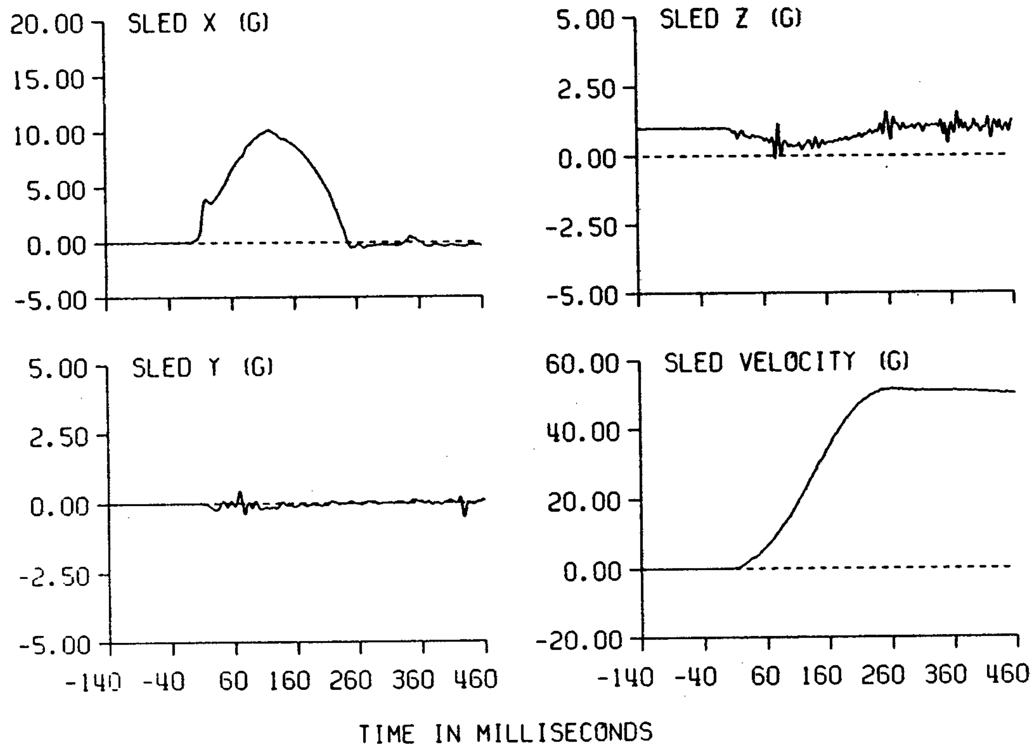

JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
TIME IN MILLISECONDS


JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
TIME IN MILLISECONDS

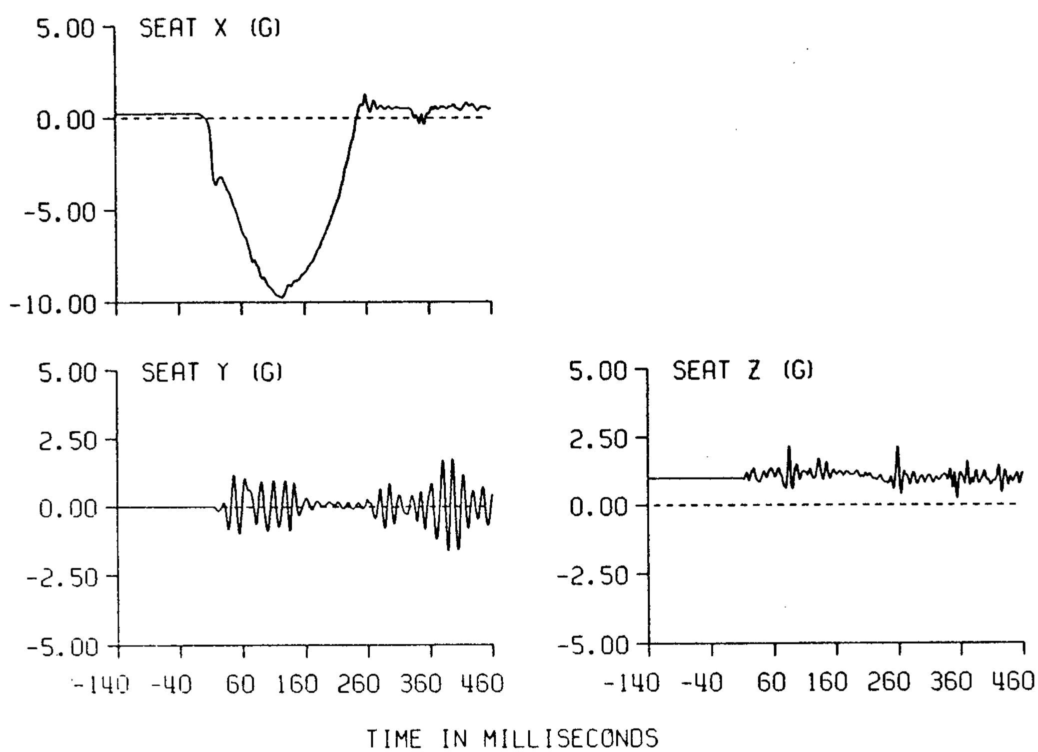

JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J
LUMBAR X (LB)
LUMBAR Z (LB)
LUMBAR Y (LB)
LUMBAR RES (LB)
50.00
0.00
-50.00
-100.00
-150.00
1500.00
1000.00
500.00
0.00
-500.00
200.00
100.00
0.00
-100.00
2000.00
1500.00
1000.00
500.00
0.00
-110 -10 90 190 290 390 490
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS


JPATS STUDY TEST: 5278 SUBJ: JPAT-S CELL: J
LUMBAR MX (IN-LB)
LUMBAR MZ (IN-LB)
LUMBAR MY (IN-LB)
LUMBAR RES (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
1000.0
500.0
0.0
-500.0
-1000.0
1000.0
500.0
0.0
-500.0
-1000.0
2000.00
1500.00
1000.00
500.00
0.00
-110 -10 90 190 290 390 490
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS

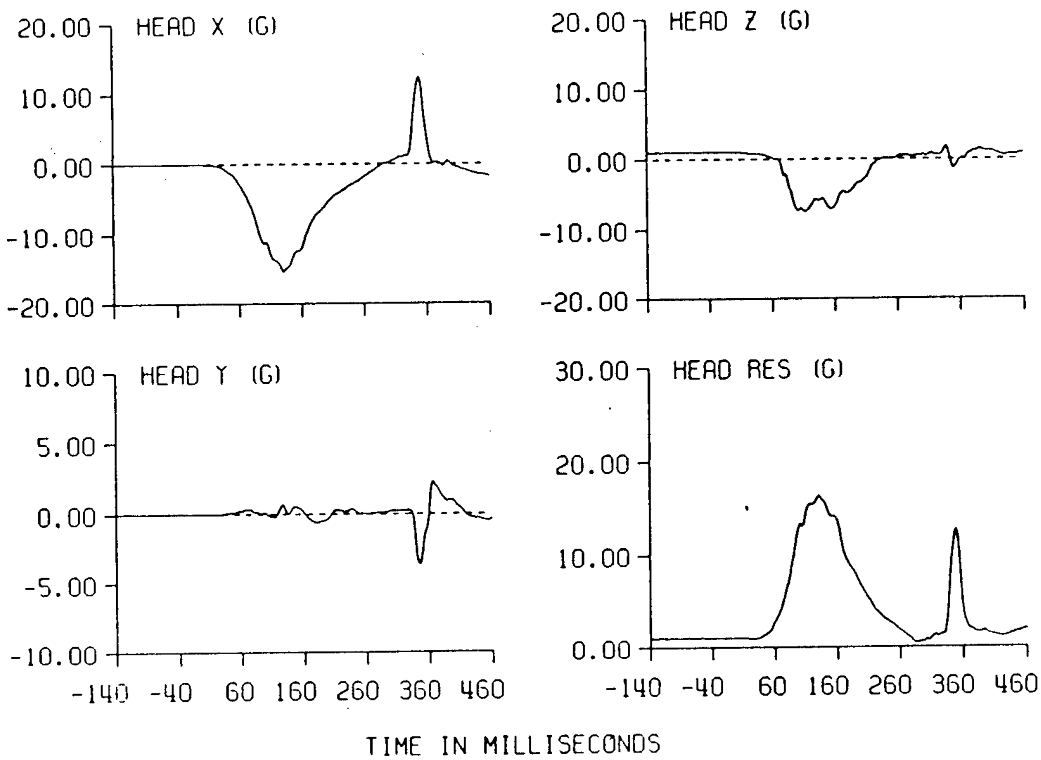
JPATS -GX STUDY TEST: 5283 SUBJ: JPAT-L CELL: J



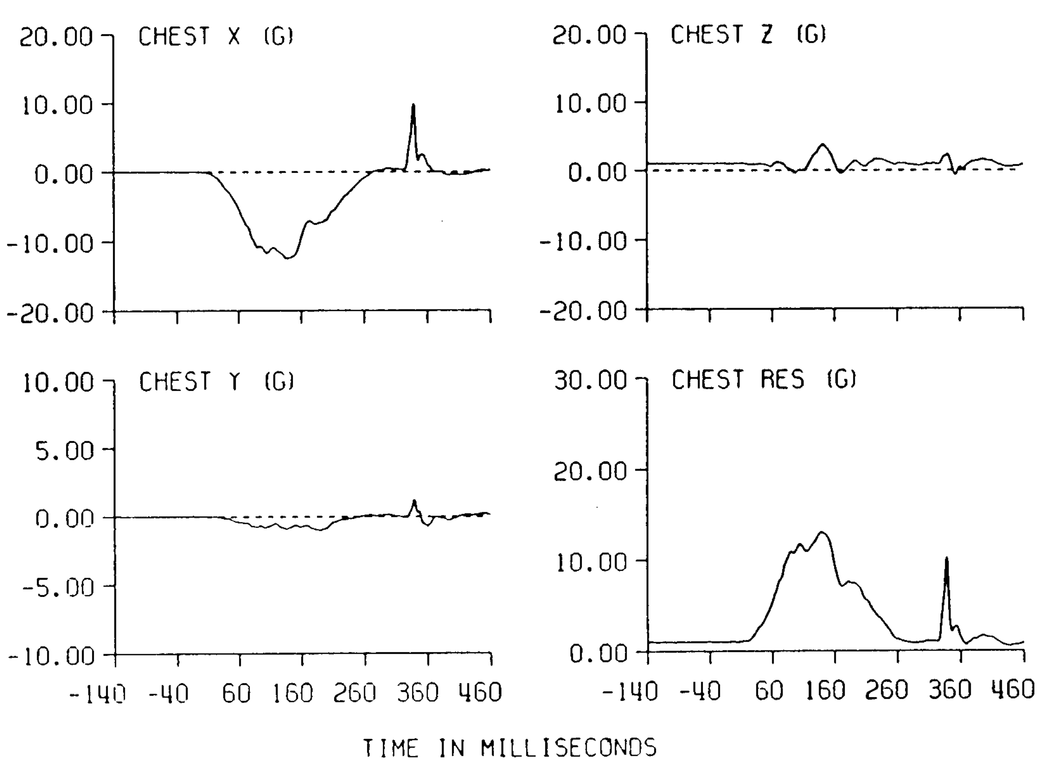
JPATS -GX STUDY TEST: 5283 SUBJ: JPAT-L CELL: J



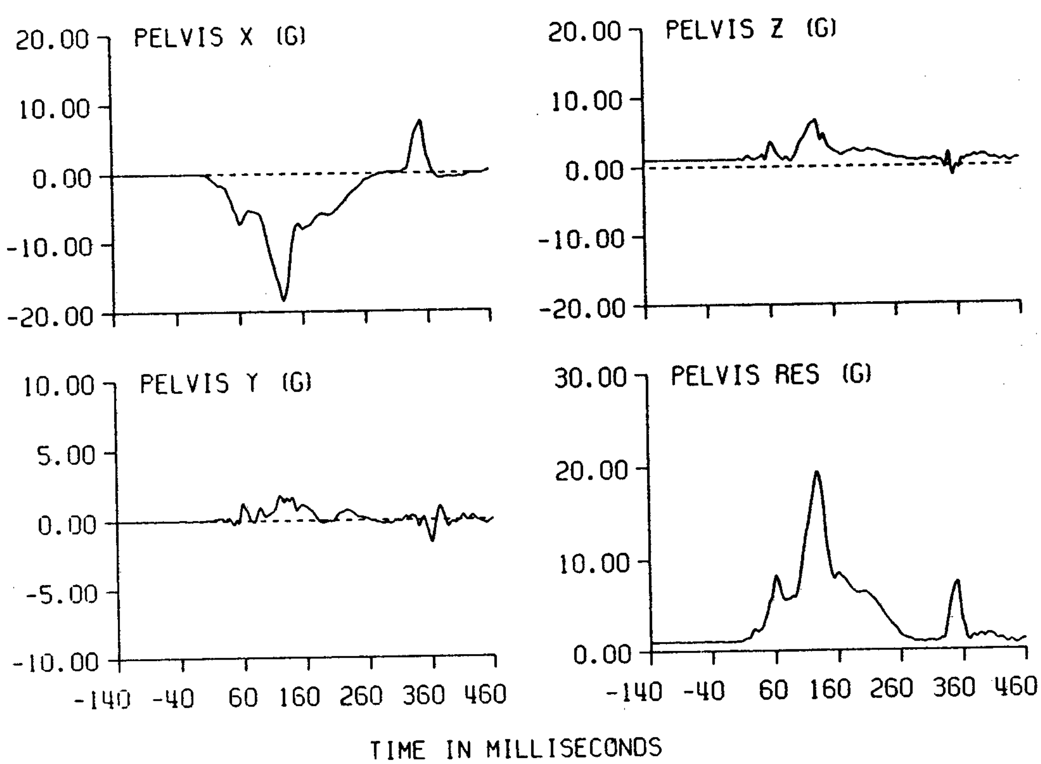
JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J



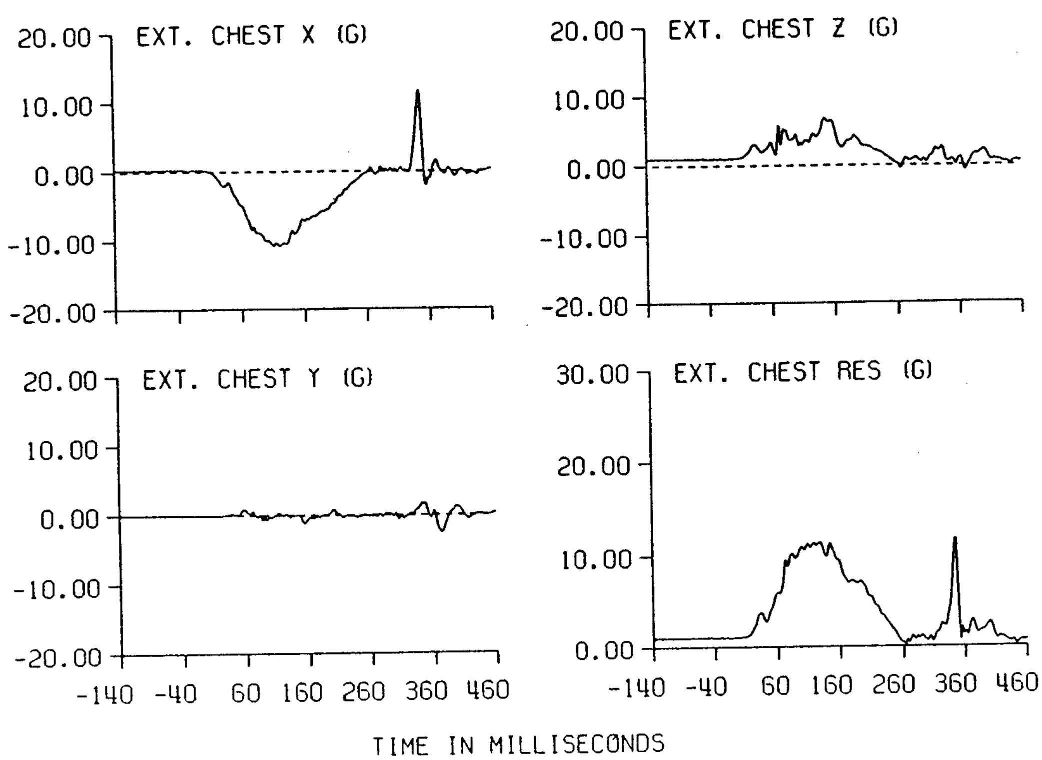
JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J

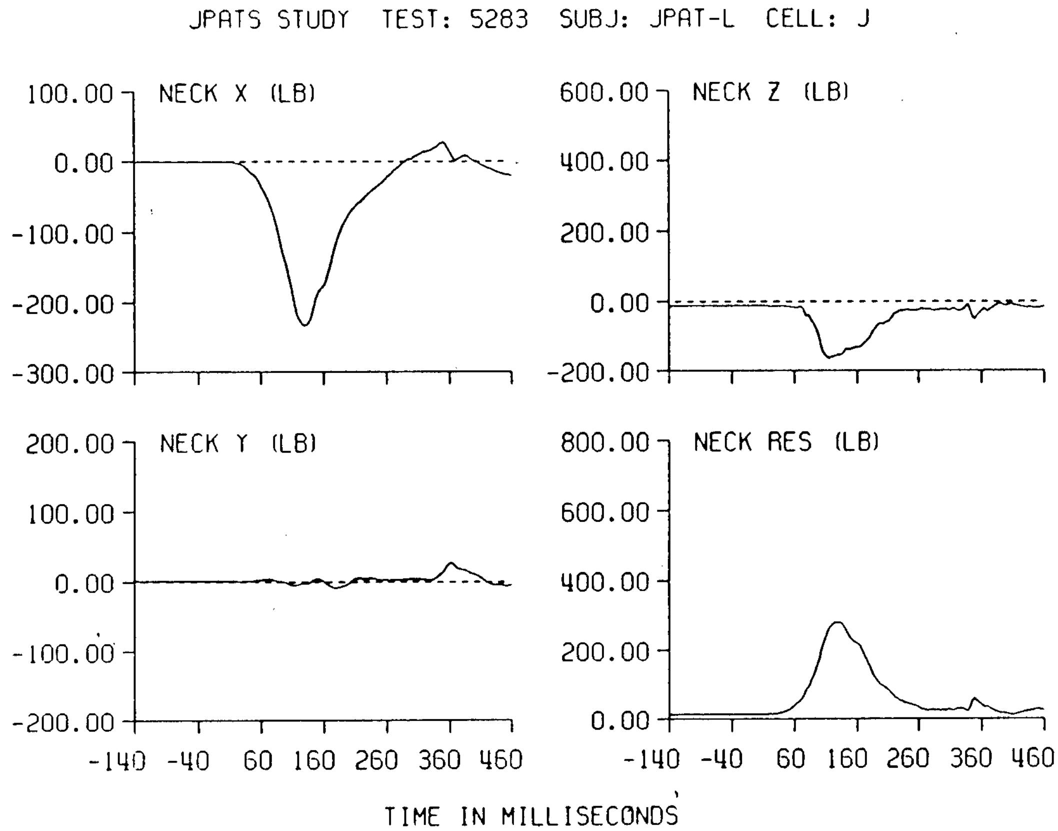


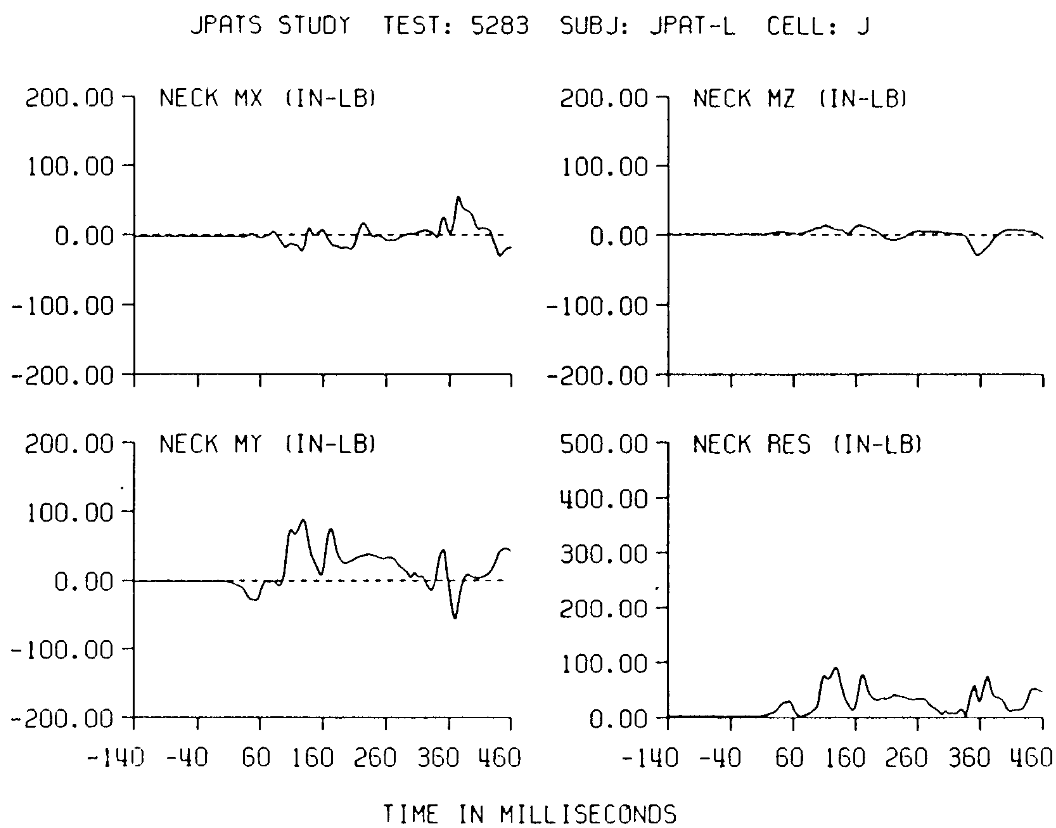
JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J



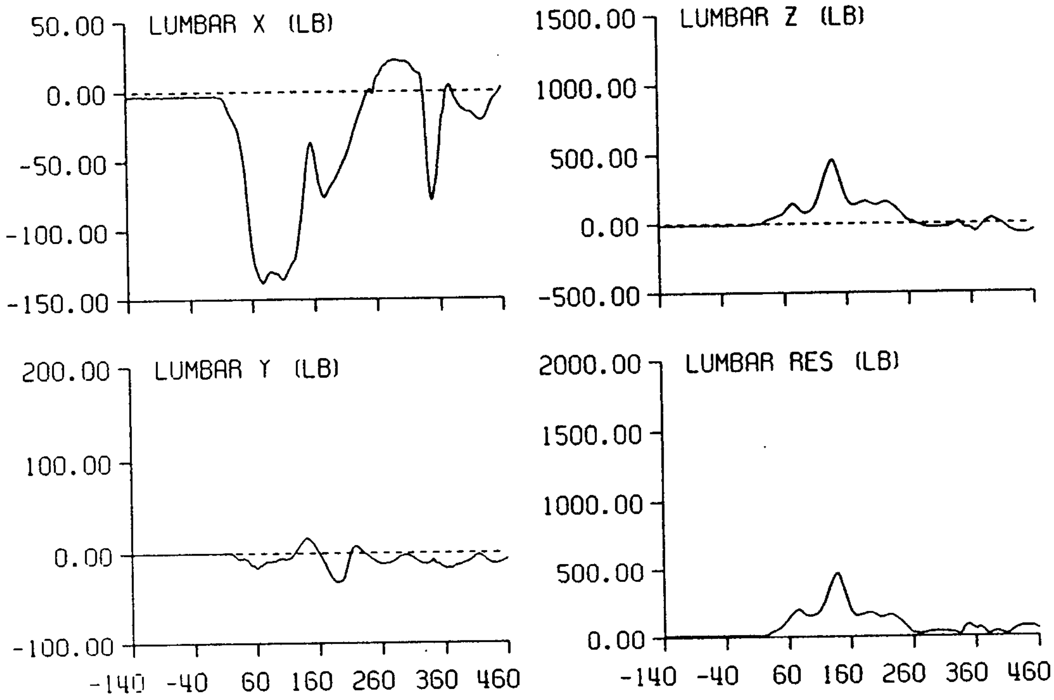
JPATS -GX STUDY TEST: 5283 SUBJ: JPAT-L CELL: J




JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
TIME IN MILLISECONDS

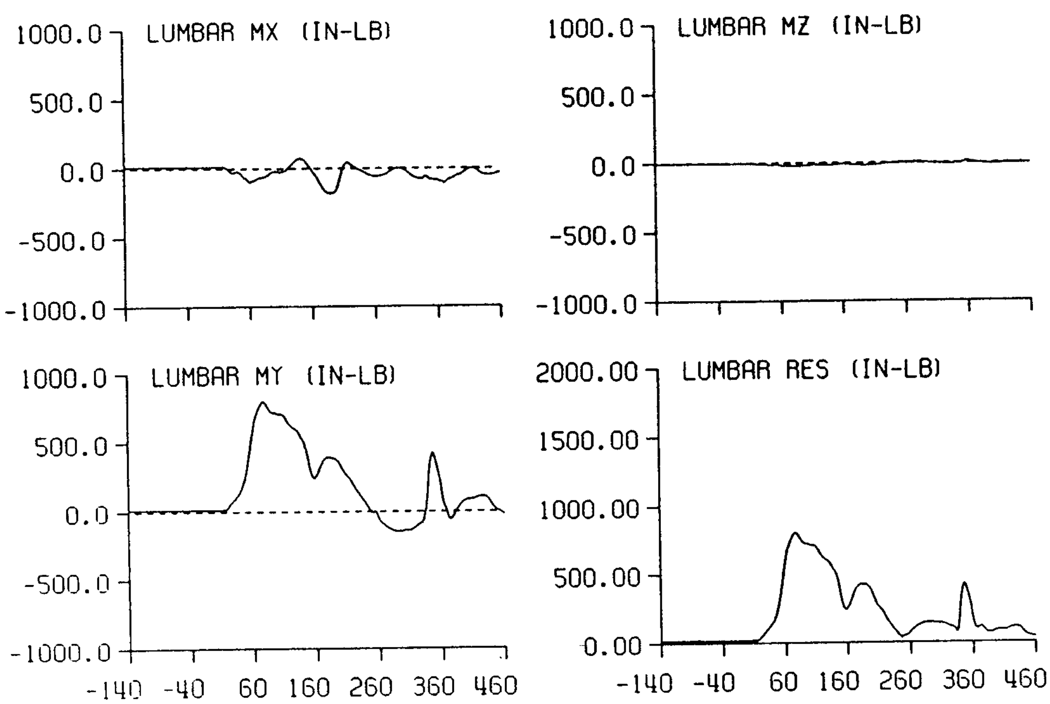

JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
TIME IN MILLISECONDS

JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J



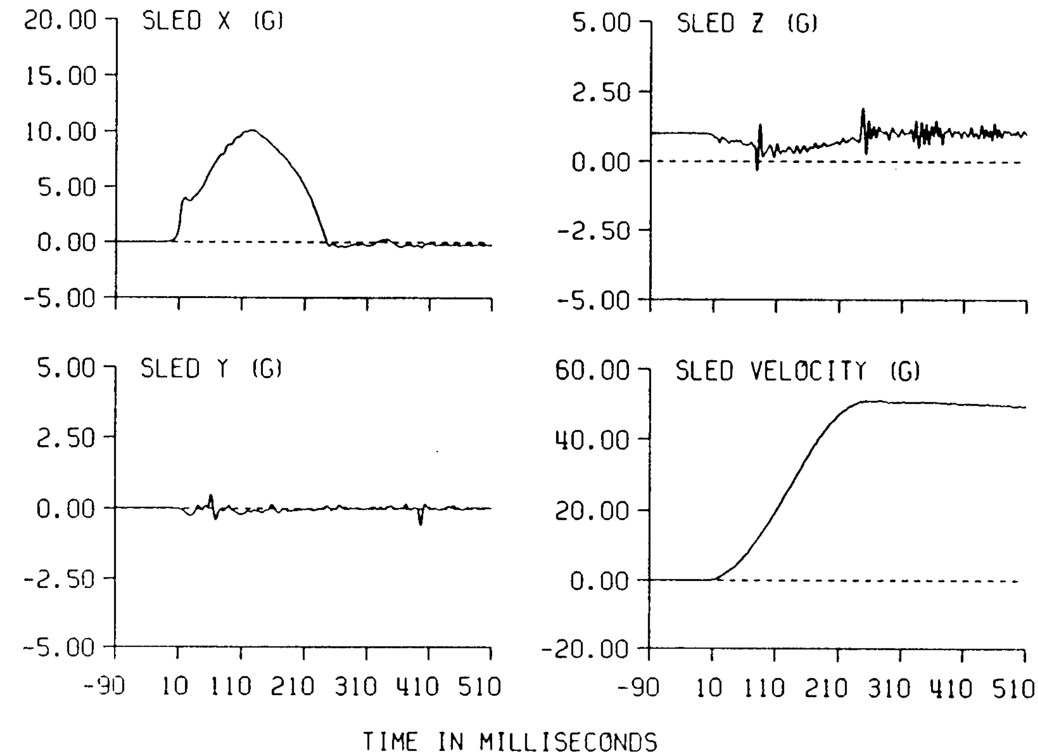
TIME IN MILLISECONDS

JPATS STUDY TEST: 5283 SUBJ: JPAT-L CELL: J

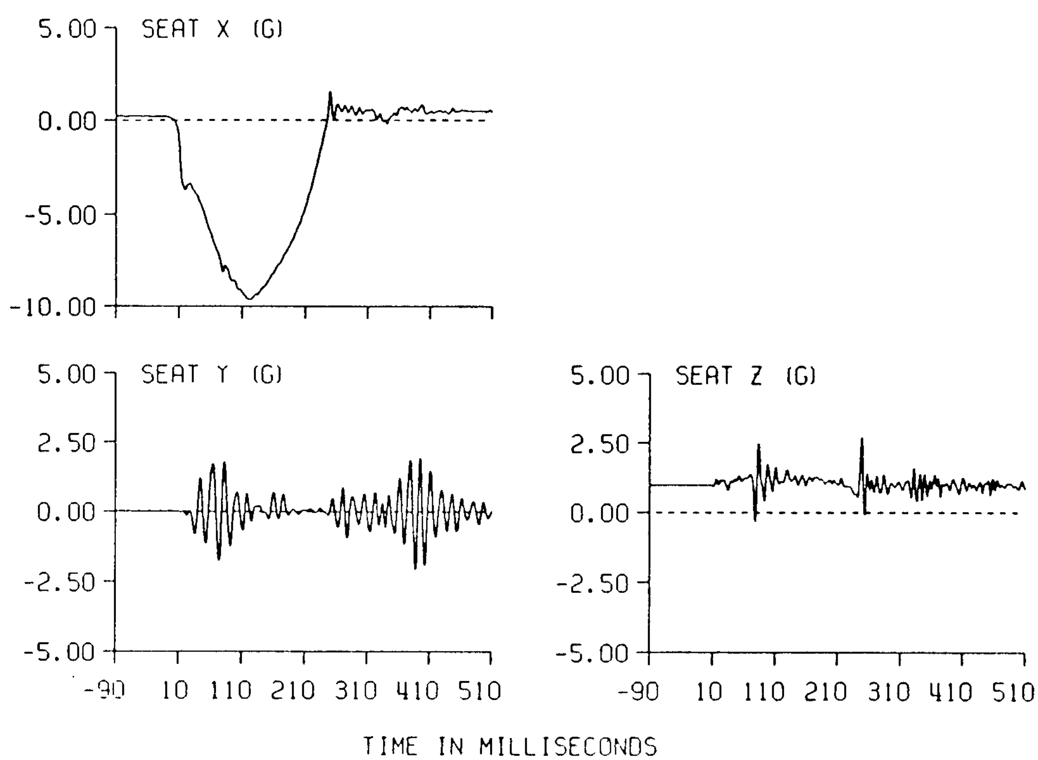


TIME IN MILLISECONDS

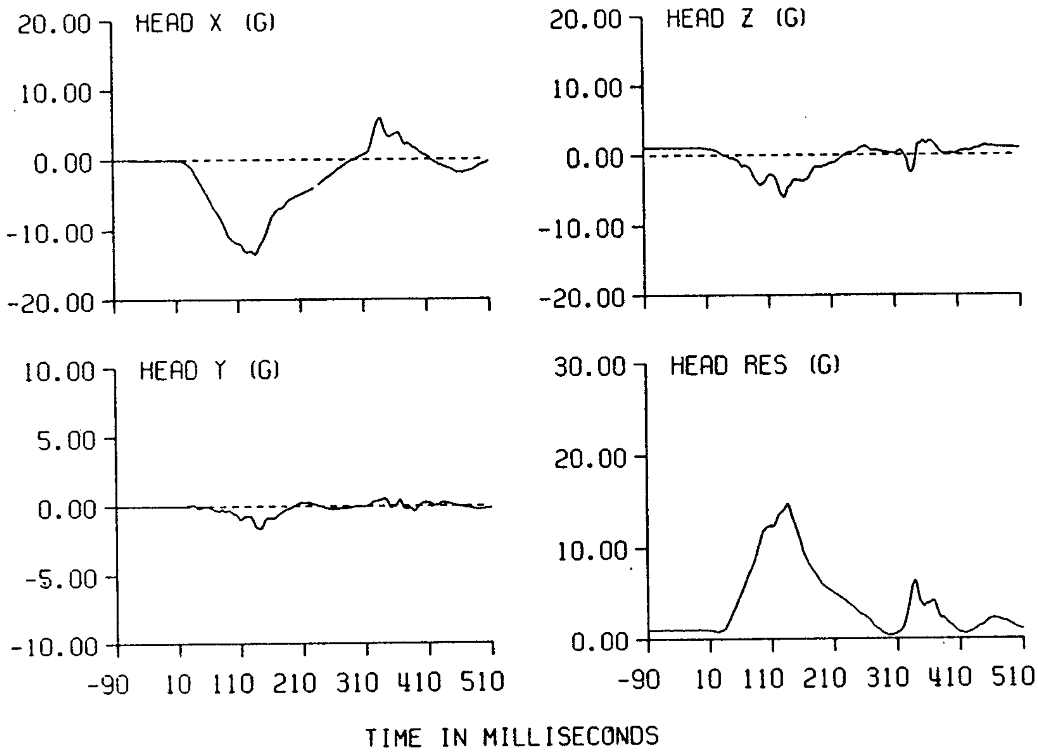
JPATS -GX STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



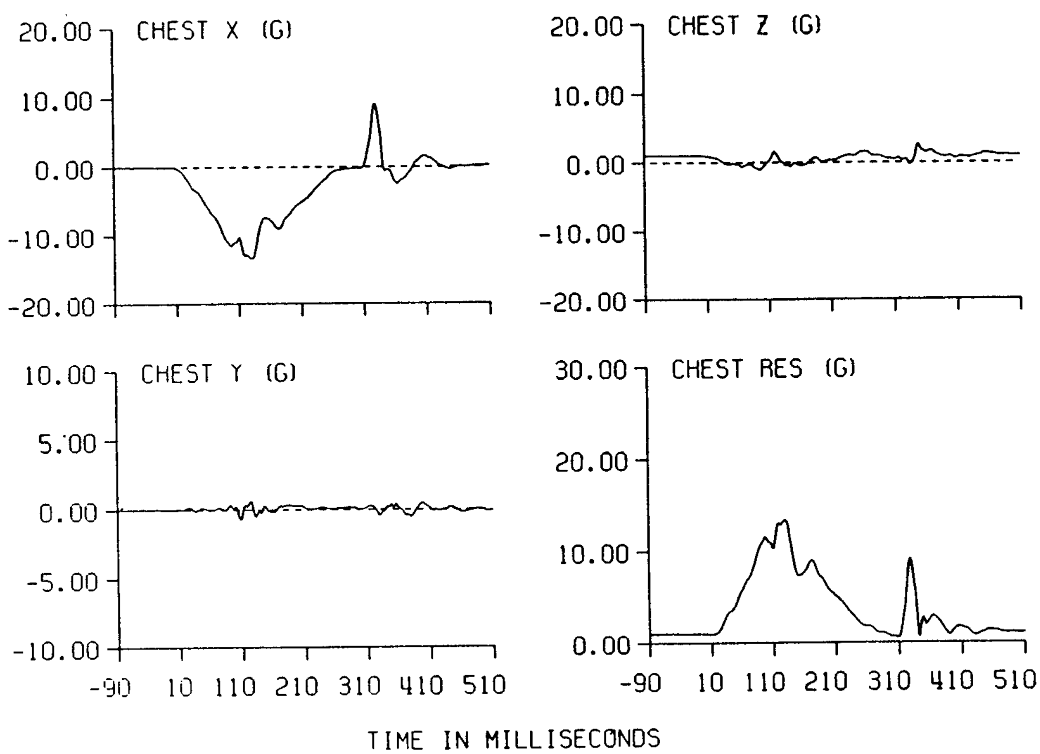
JPATS -GX STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



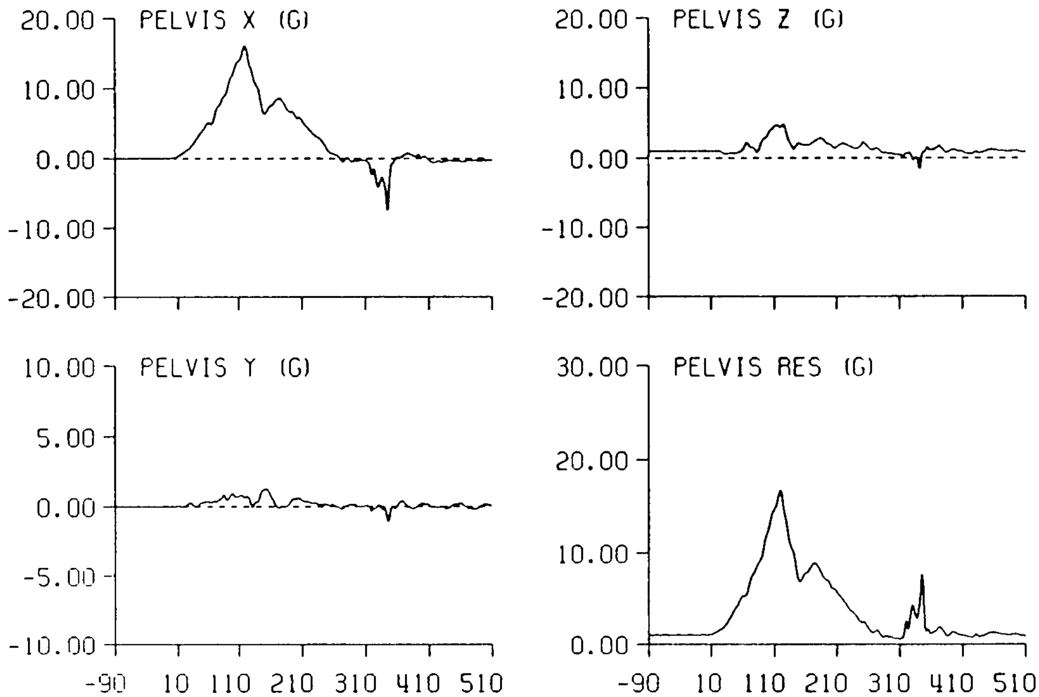
JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J

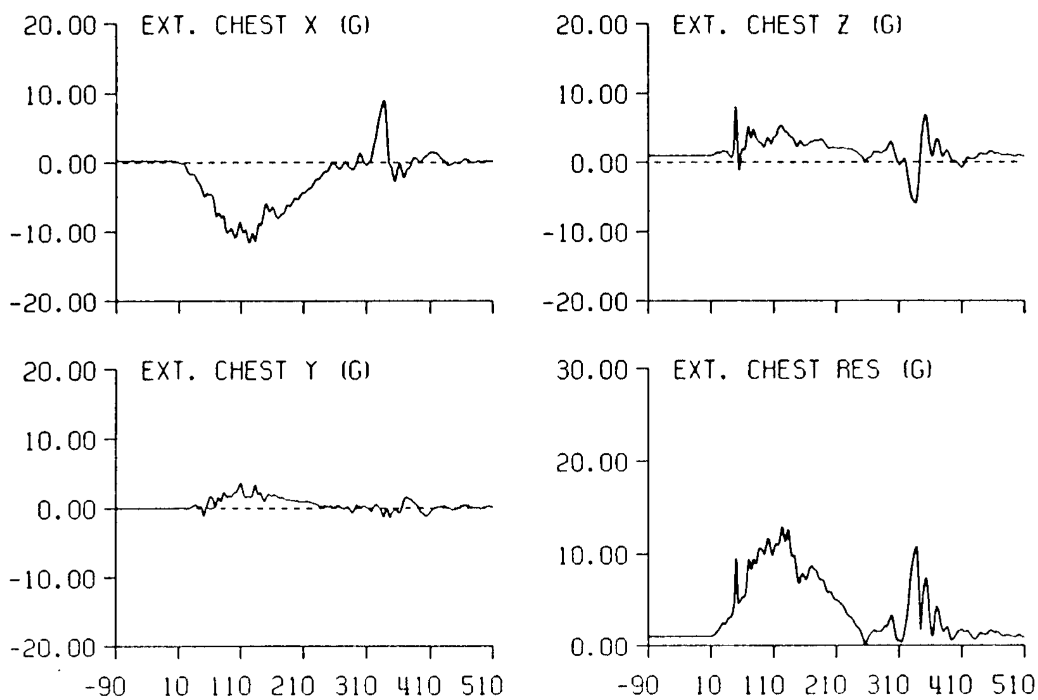


JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



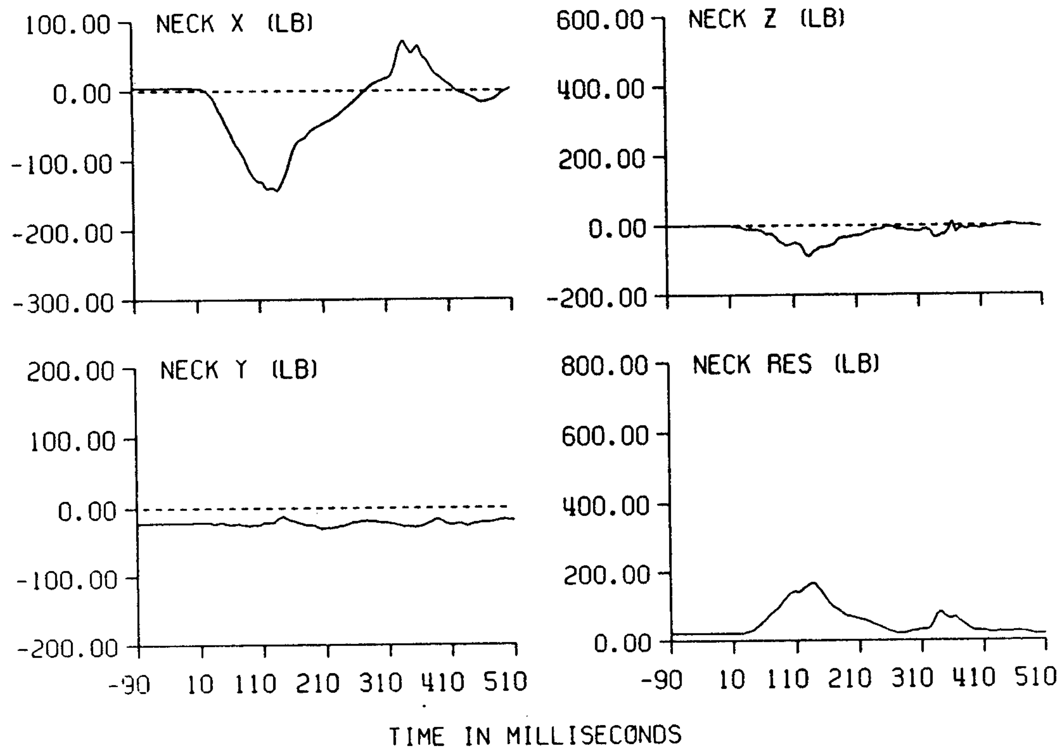
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5274 SUBJ: ADAM-L CELL: J

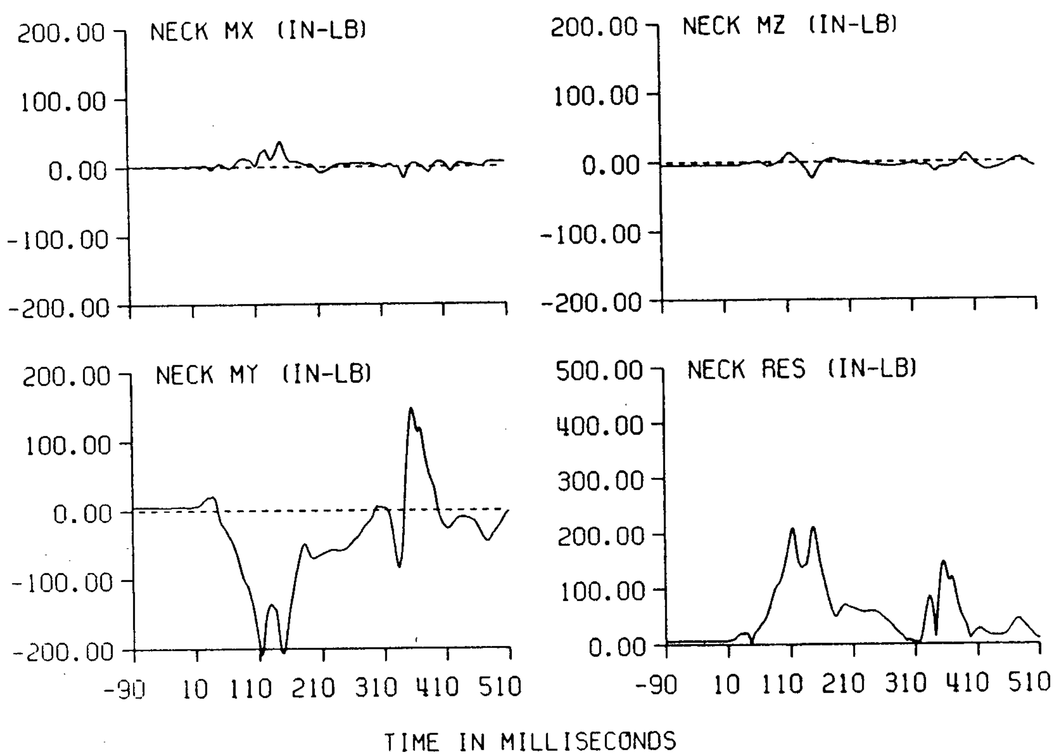


TIME IN MILLISECONDS

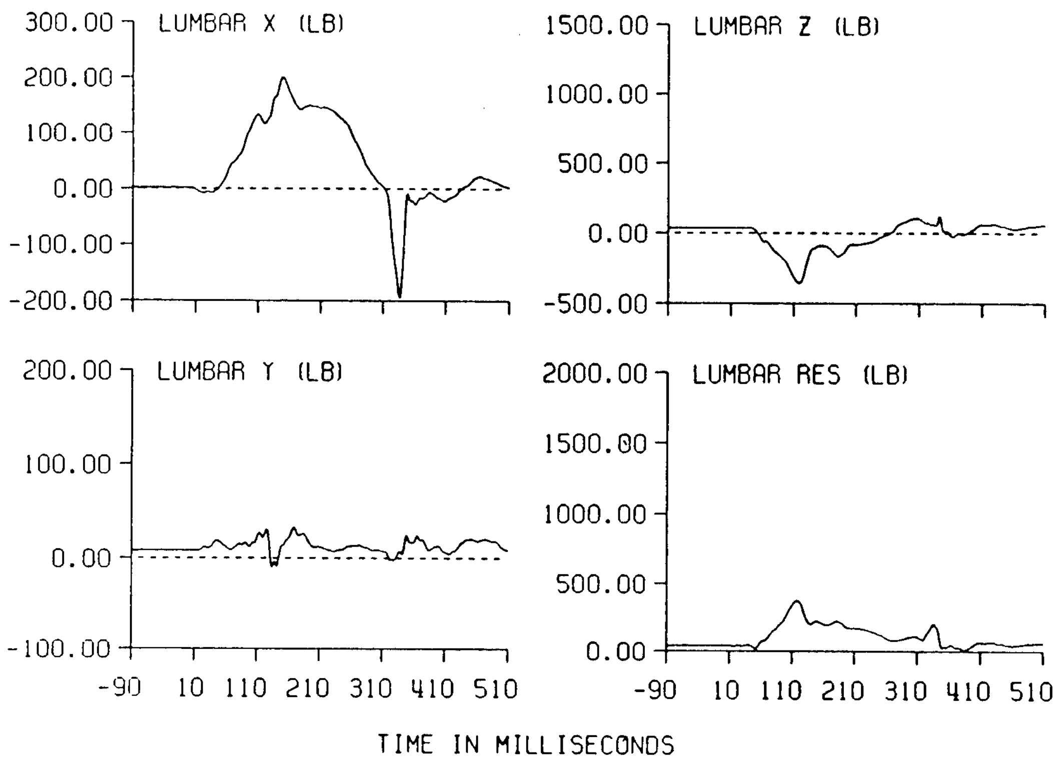
JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



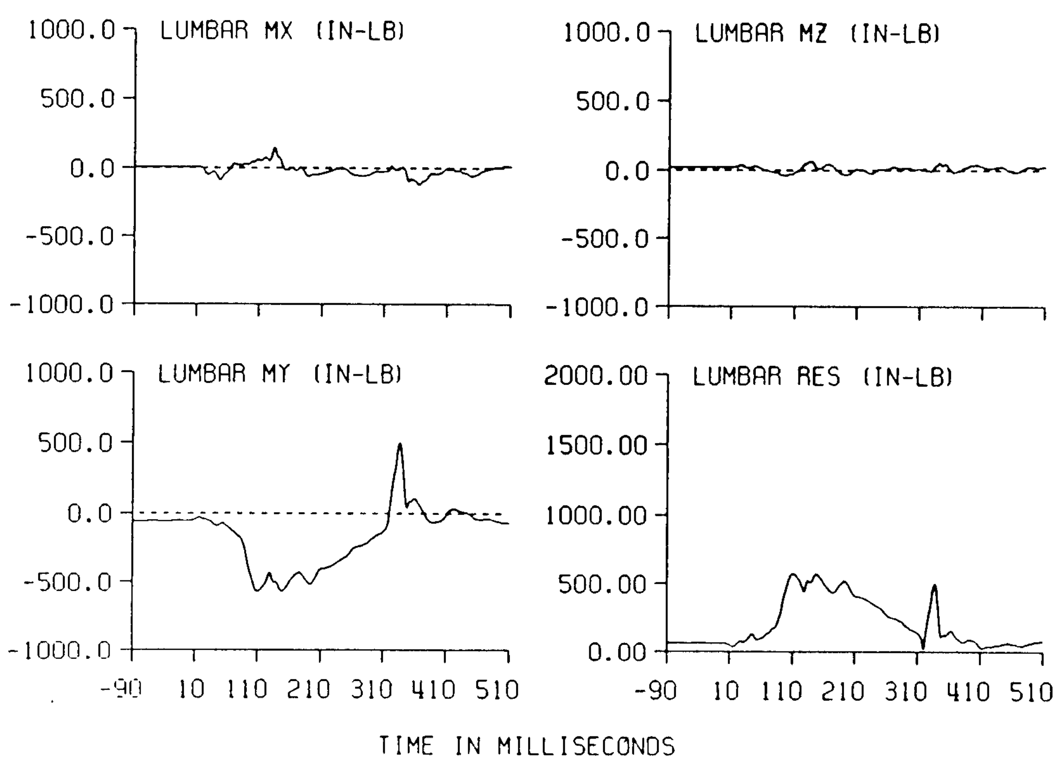
JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



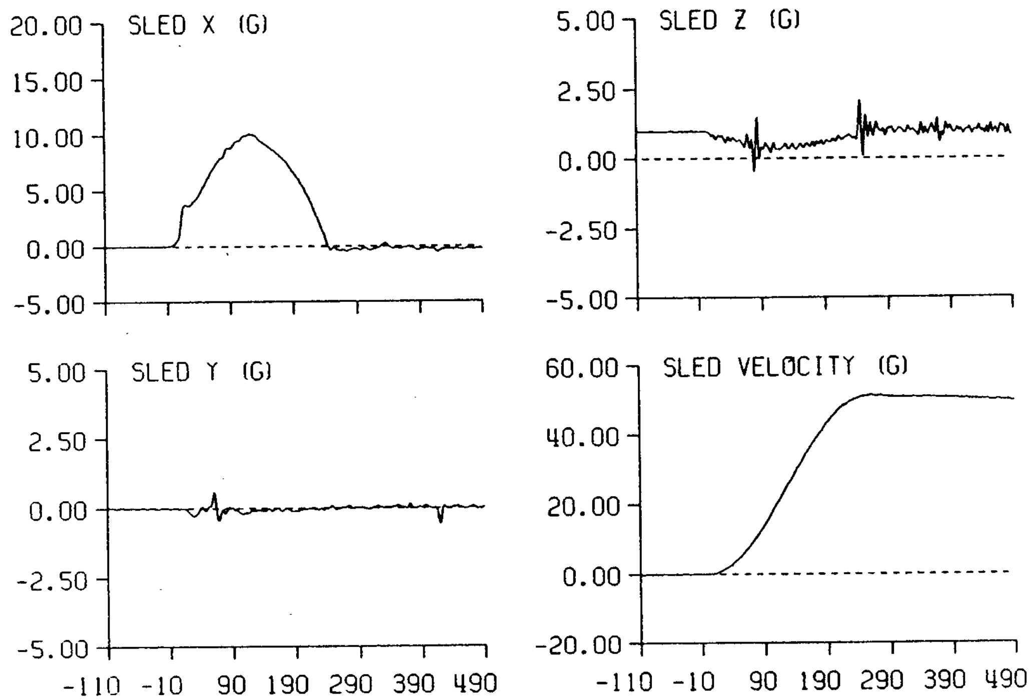
JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J



JPATS STUDY TEST: 5274 SUBJ: ADAM-L CELL: J

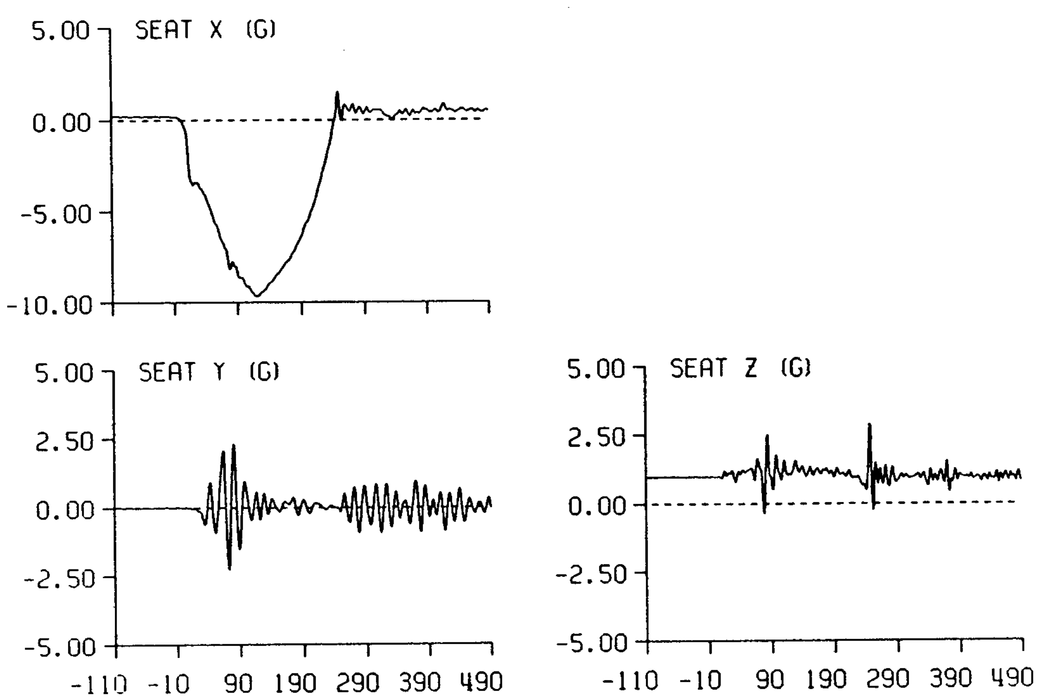


JPATS -GX STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1



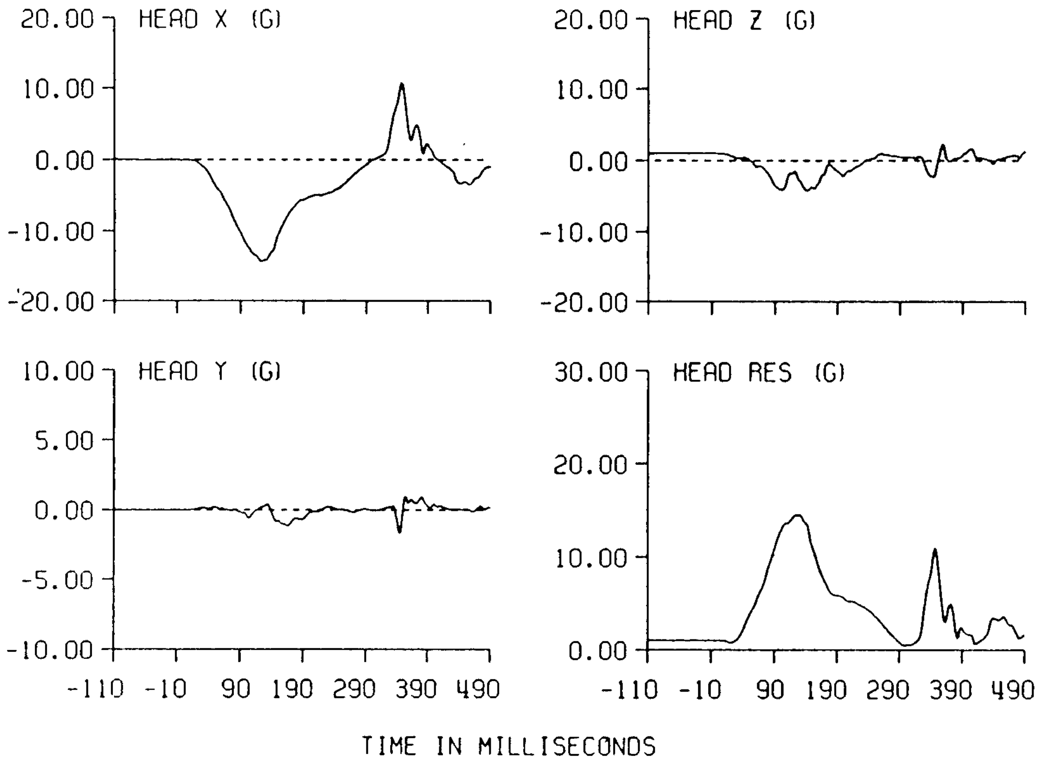
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

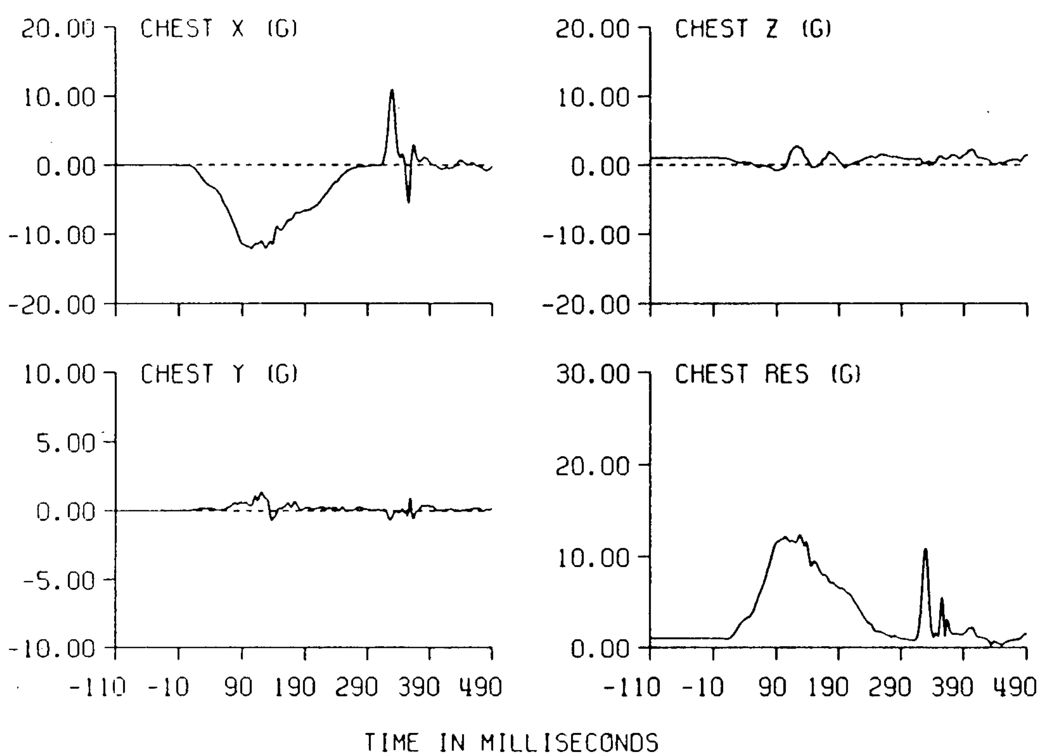


TIME IN MILLISECONDS

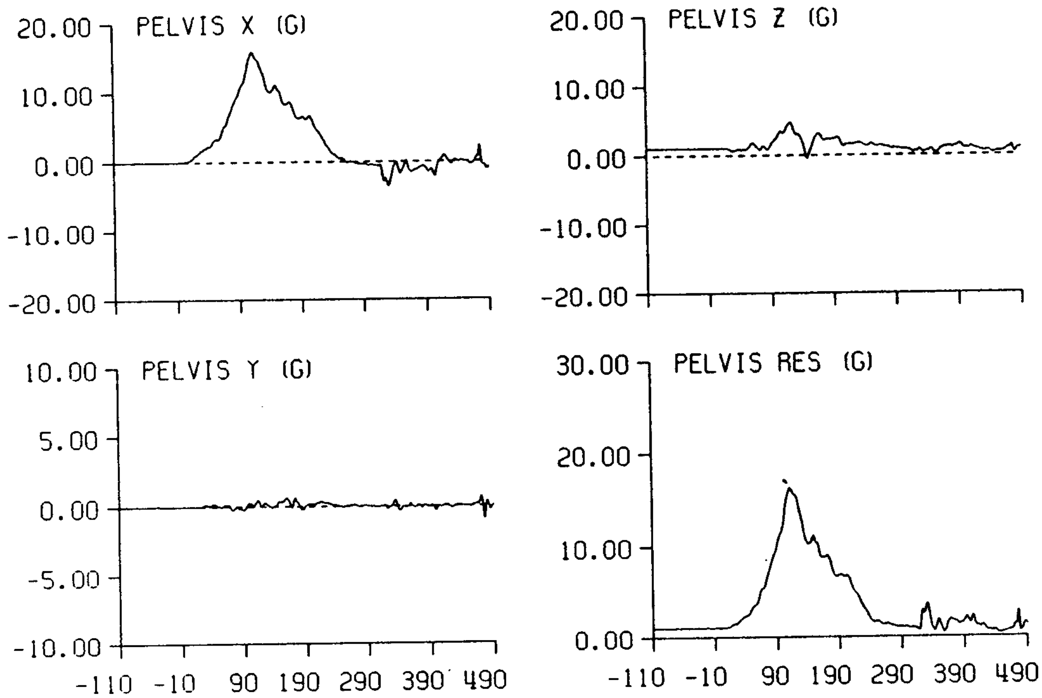
JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1



JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

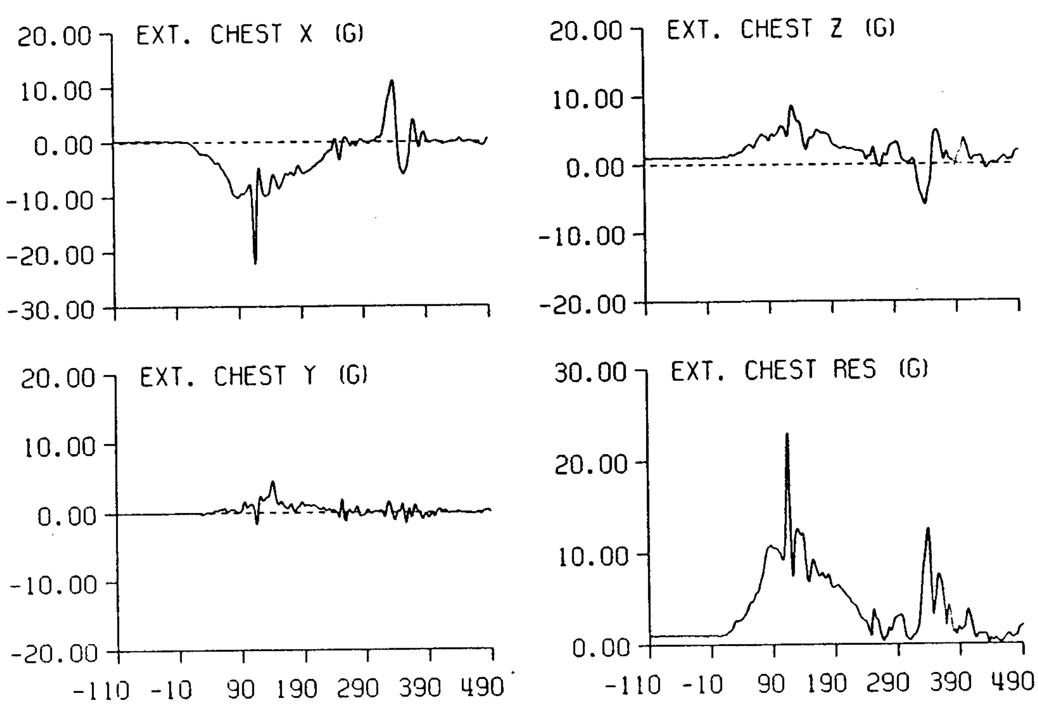


JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1



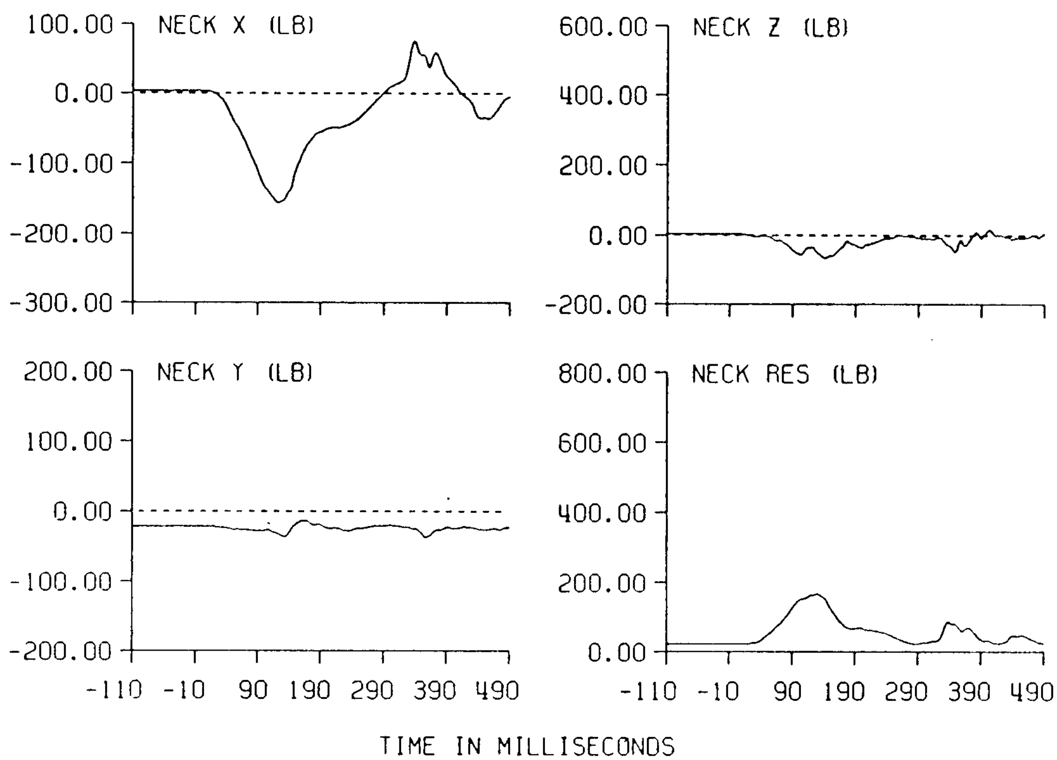
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

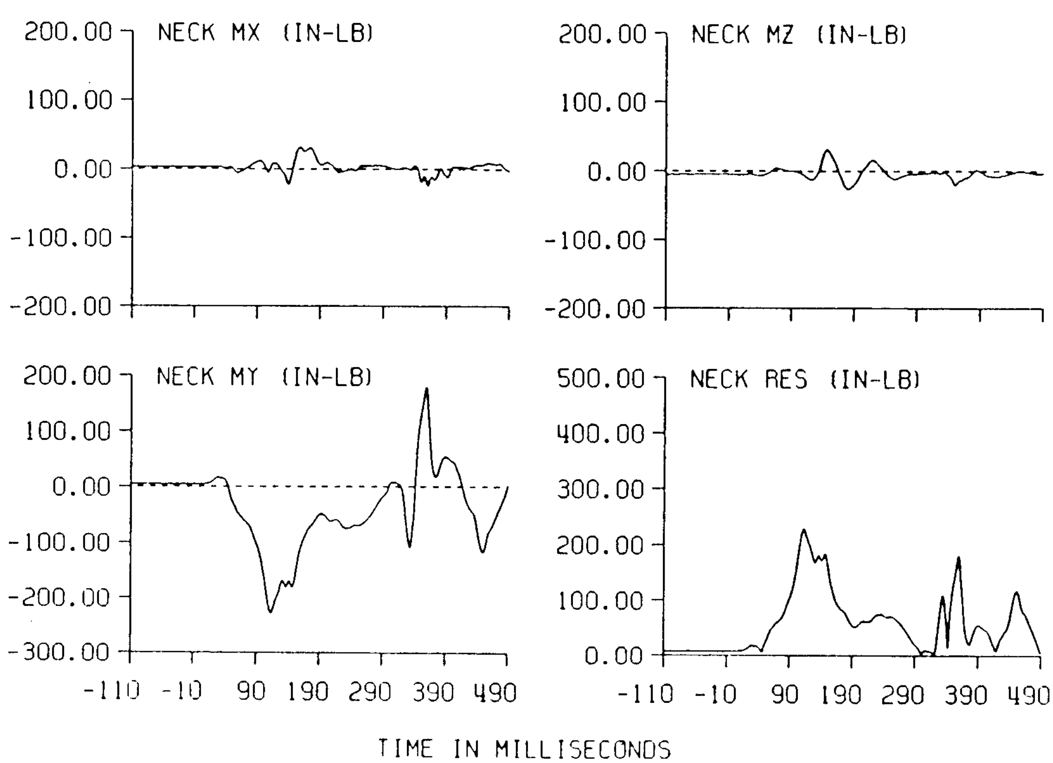


TIME IN MILLISECONDS

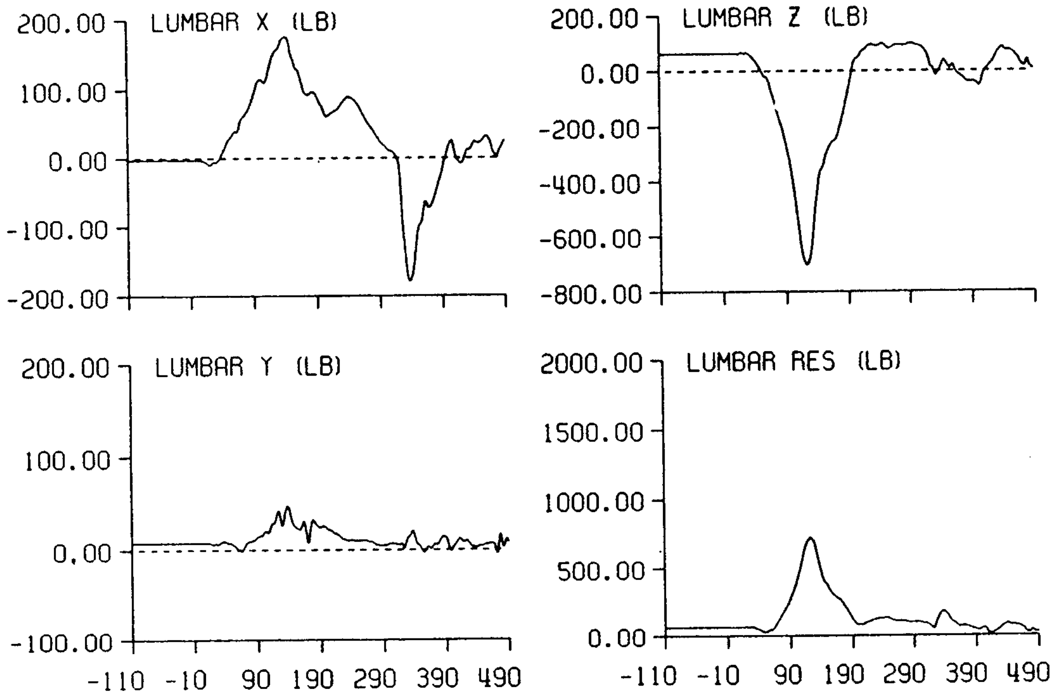
JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1



JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

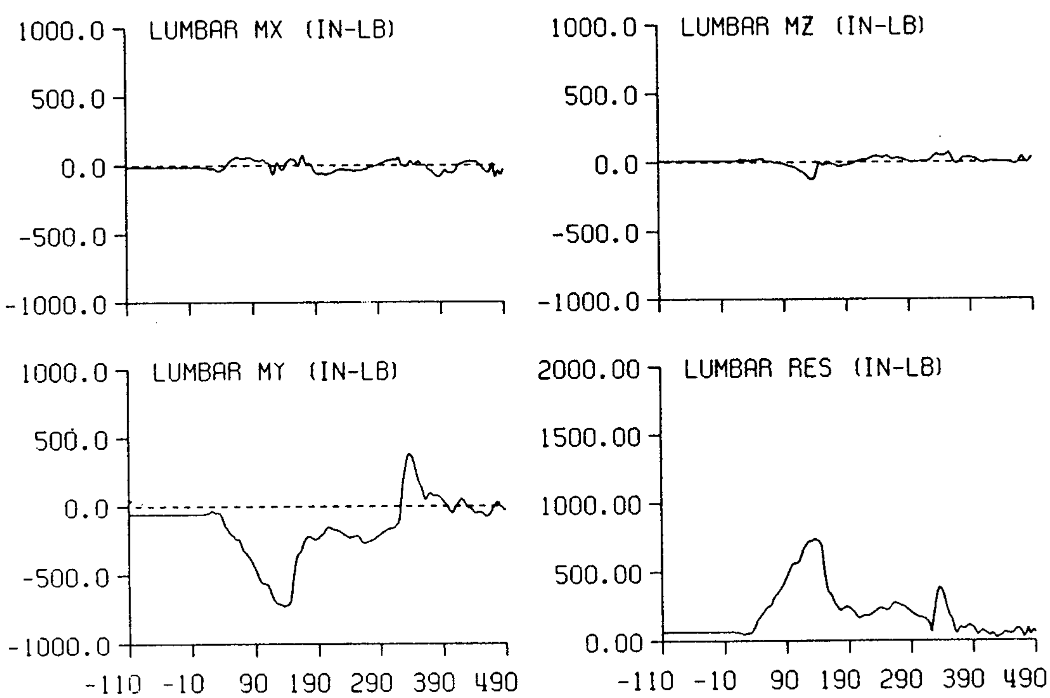


JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

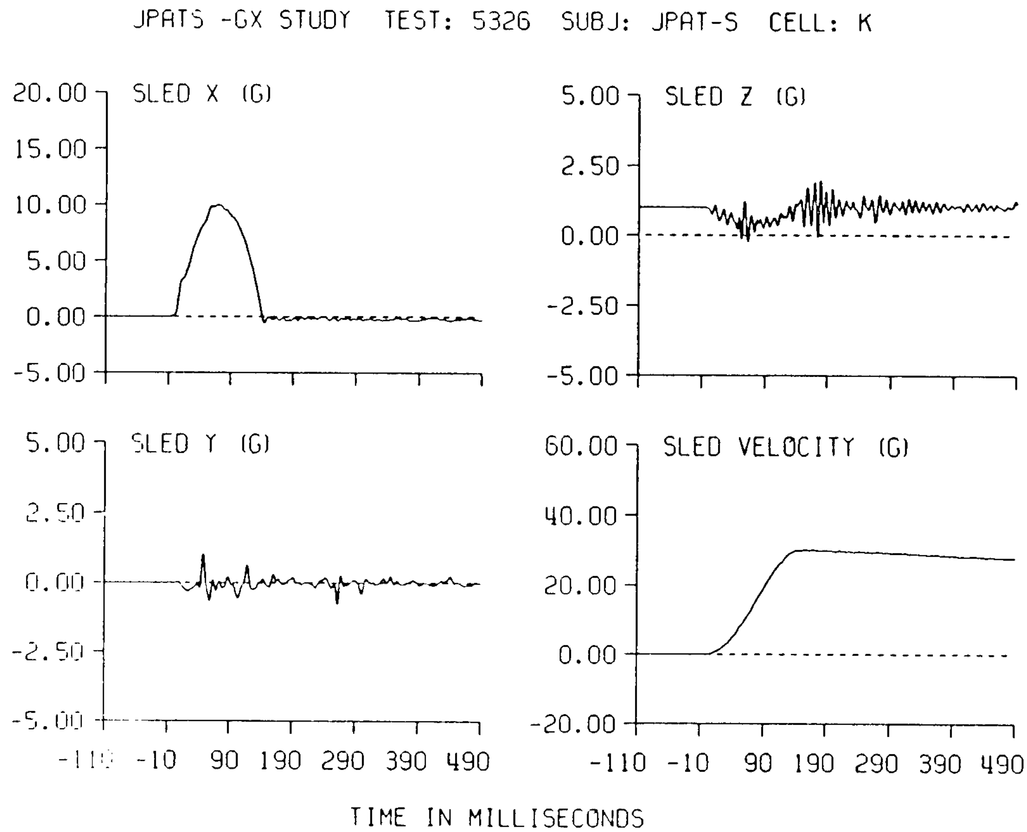


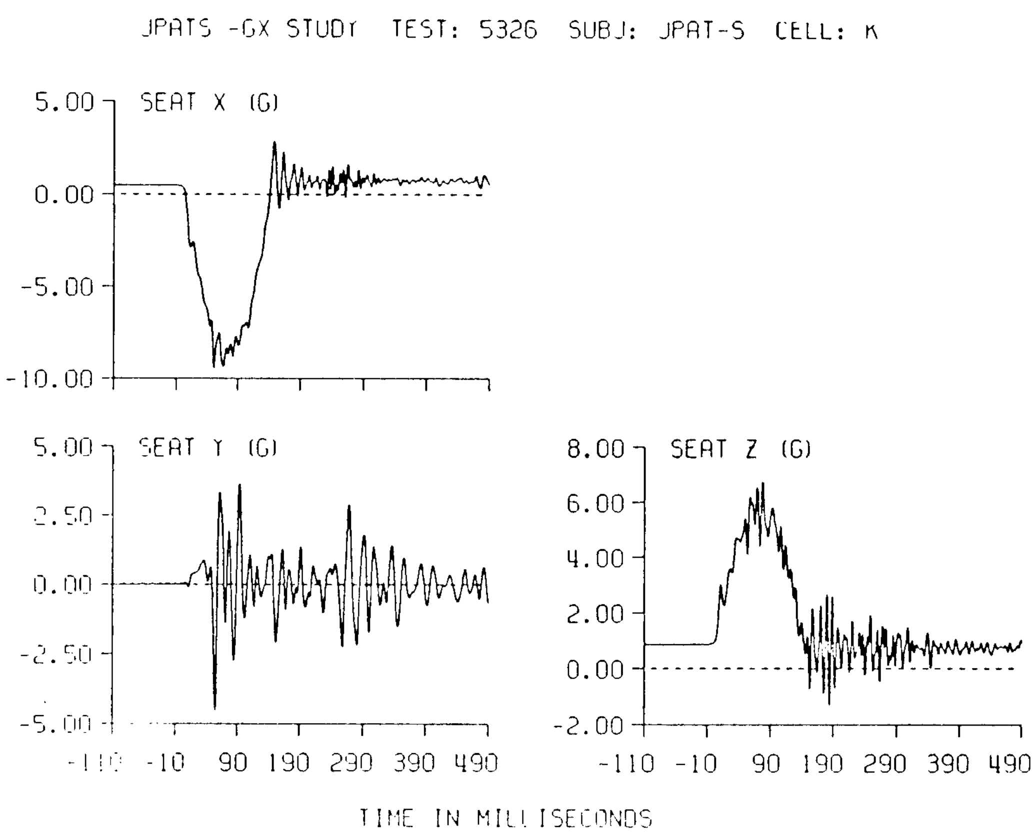
TIME IN MILLISECONDS

JPATS STUDY TEST: 5271 SUBJ: ADAM-L CELL: J1

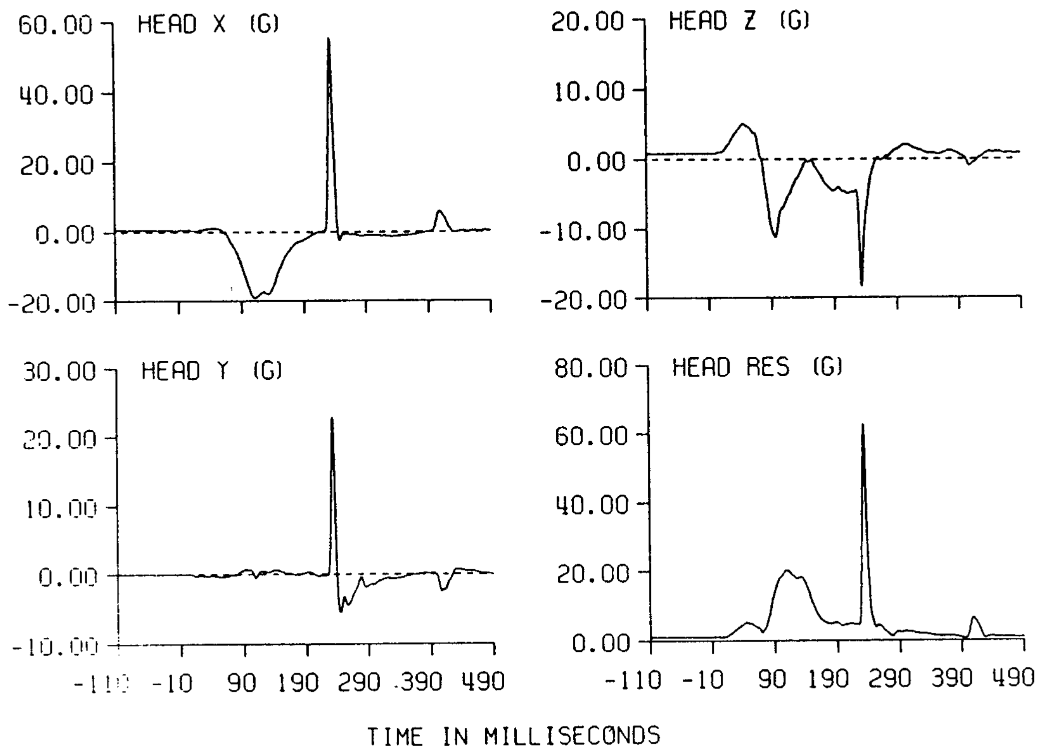


TIME IN MILLISECONDS

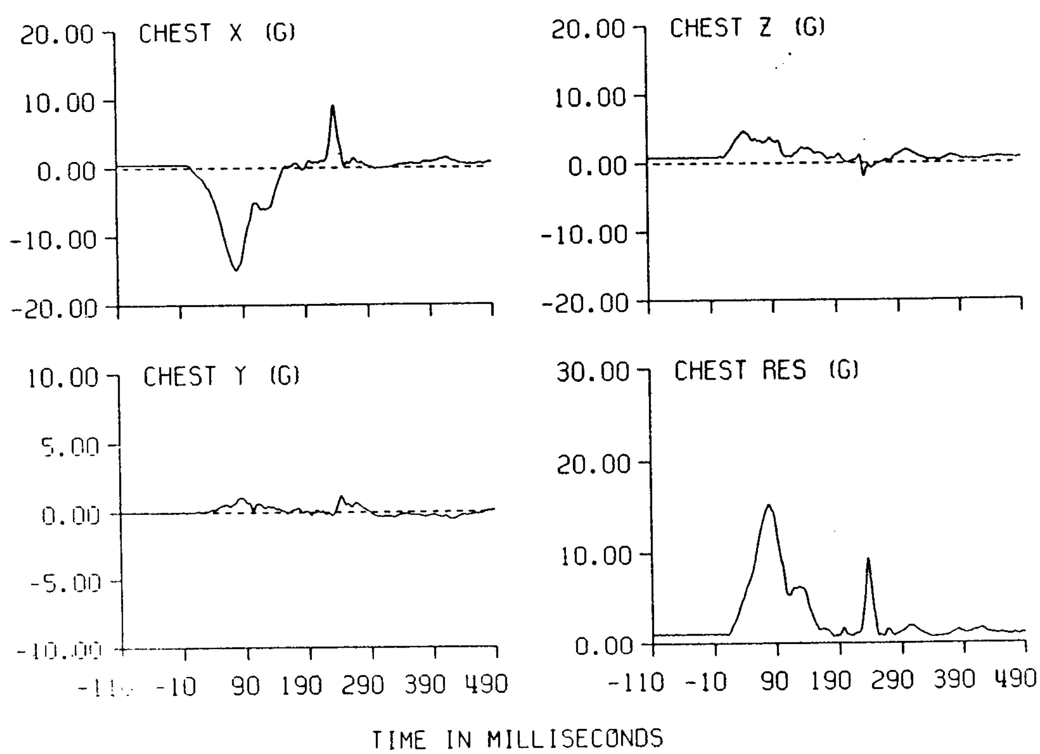

JPATS -GX STUDY TEST: 5326 SUBJ: JPAT-S CELL: K
SLED X (G)
SLED Z (G)
SLED Y (G)
SLED VELOCITY (G)
20.00
15.00
10.00
5.00
0.00
-5.00
2.50
-2.50
60.00
40.00
20.00
-20.00
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS


JPATS -GX STUDY TEST: 5326 SUBJ: JPAT-S CELL: K
SEAT X (G)
SEAT Y (G)
SEAT Z (G)
5.00
0.00
-5.00
-10.00
2.50
-2.50
8.00
6.00
4.00
2.00
-2.00
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS

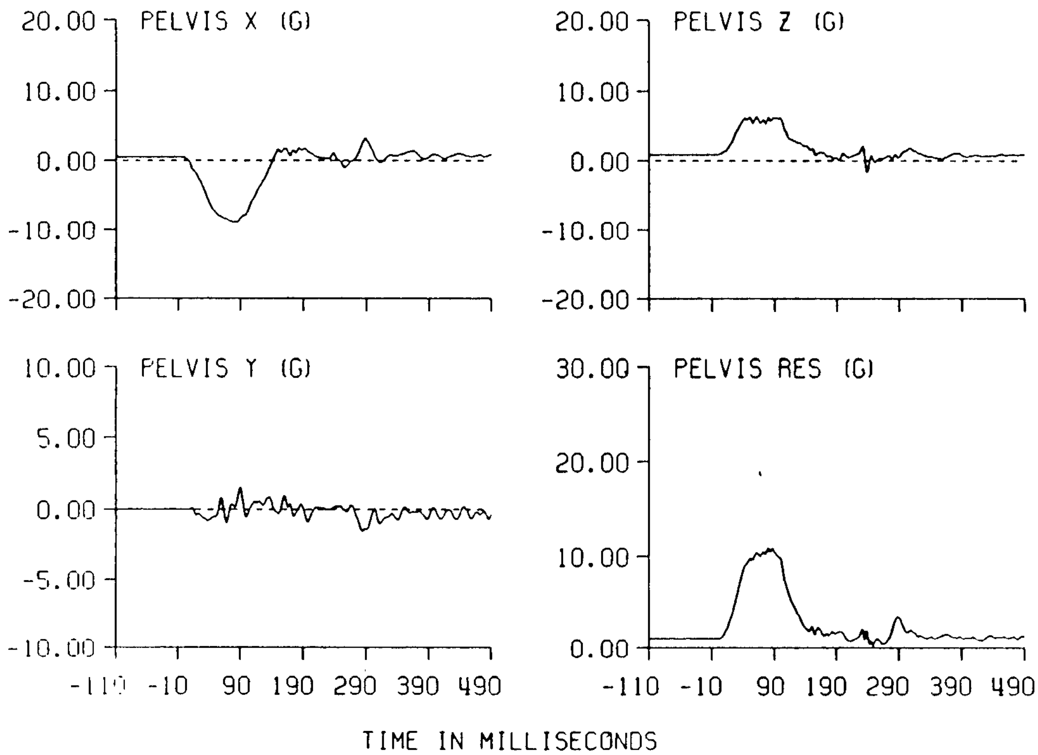
JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K



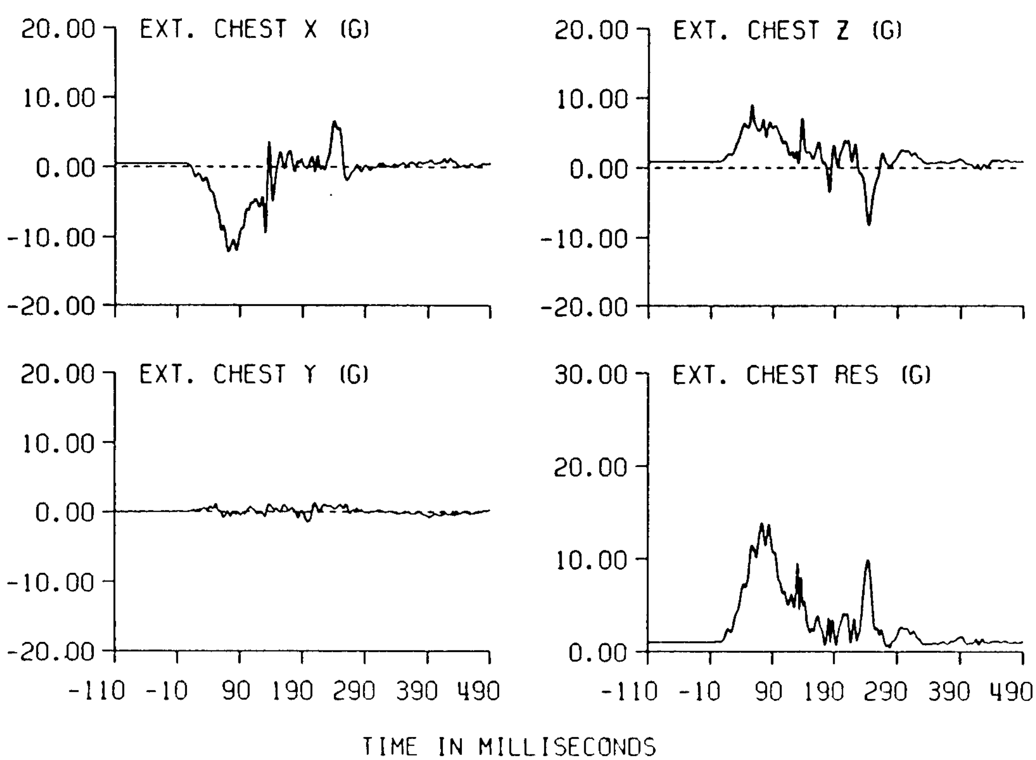
JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K



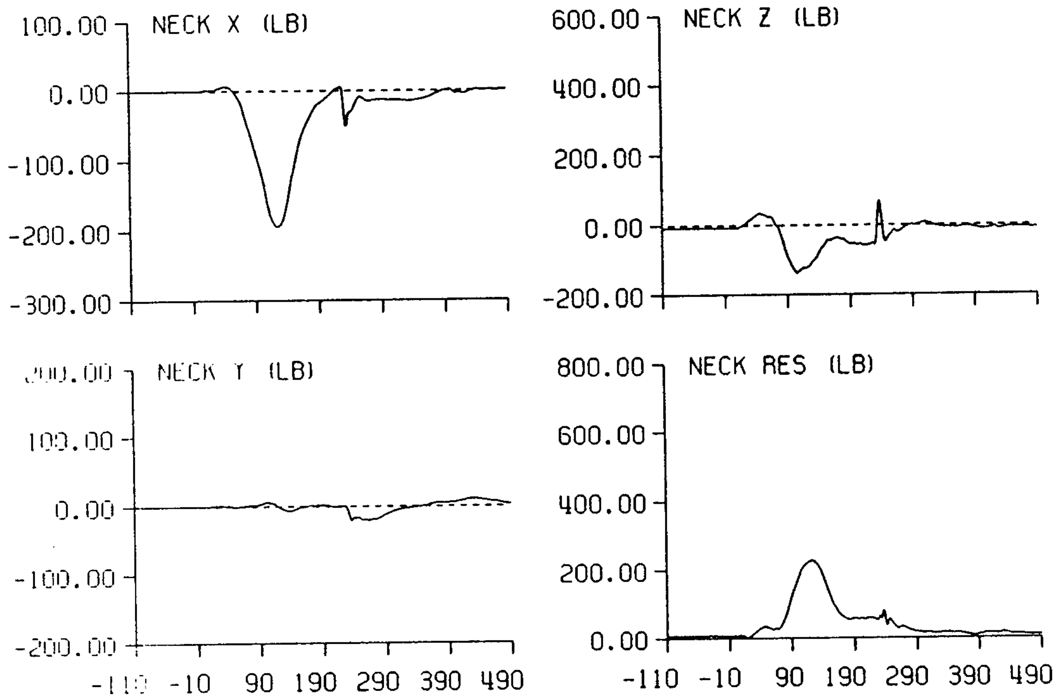
JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K



JPATS -GX STUDY TEST: 5326 SUBJ: JPAT-S CELL: K

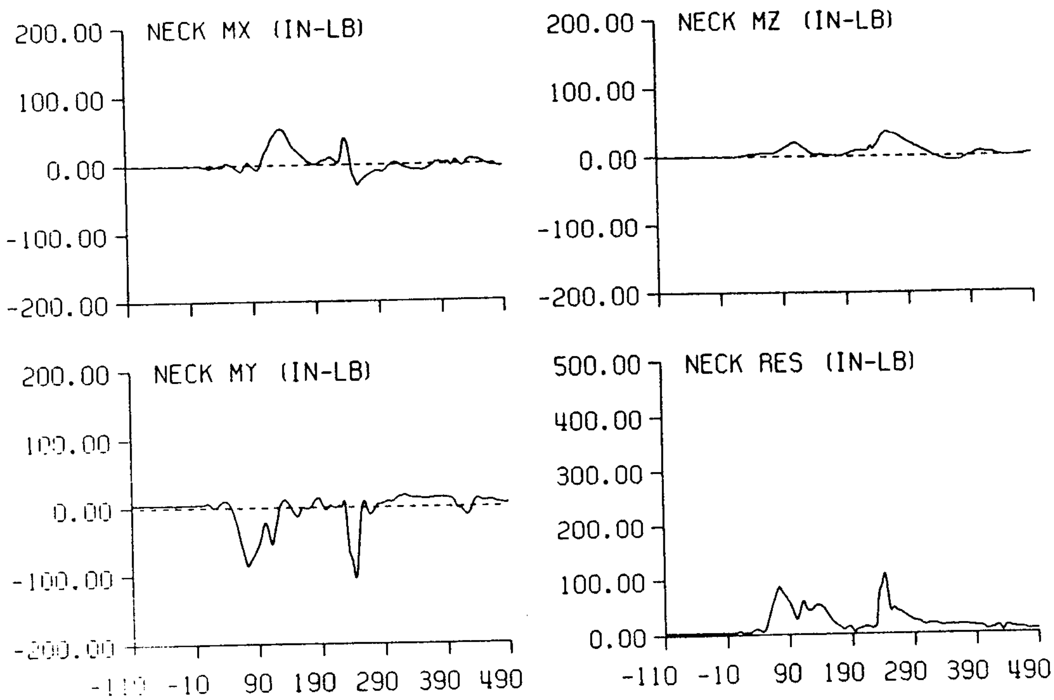


JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K

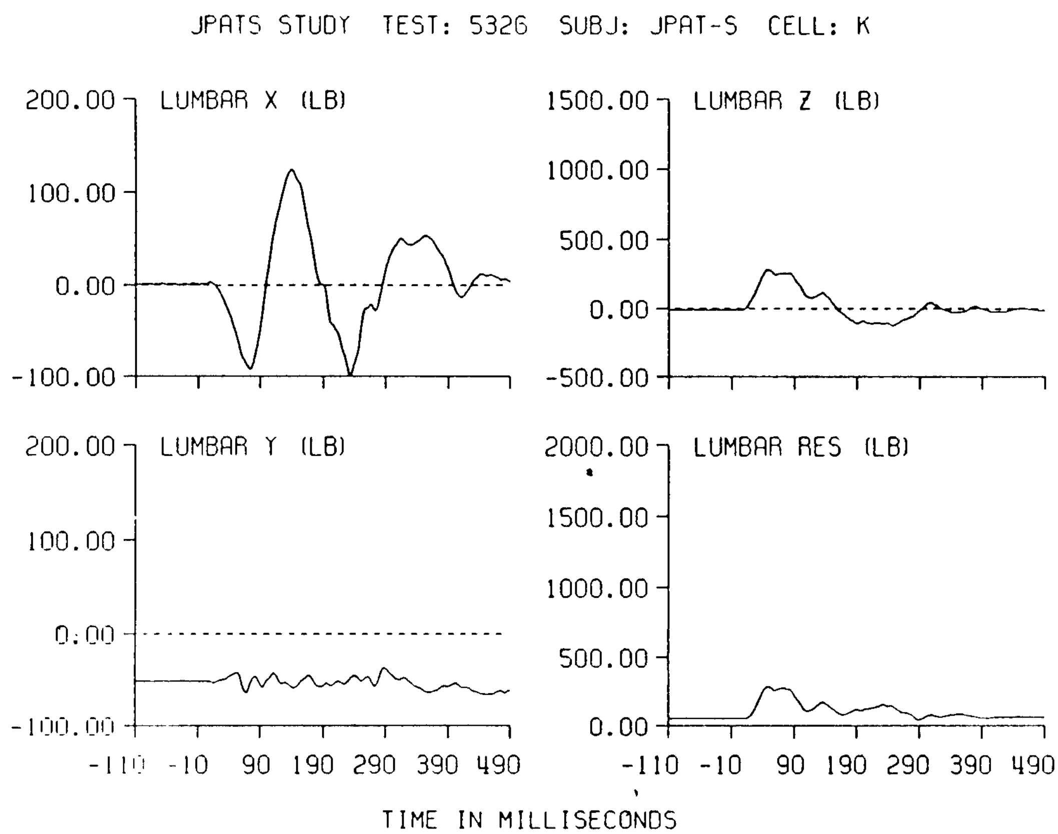


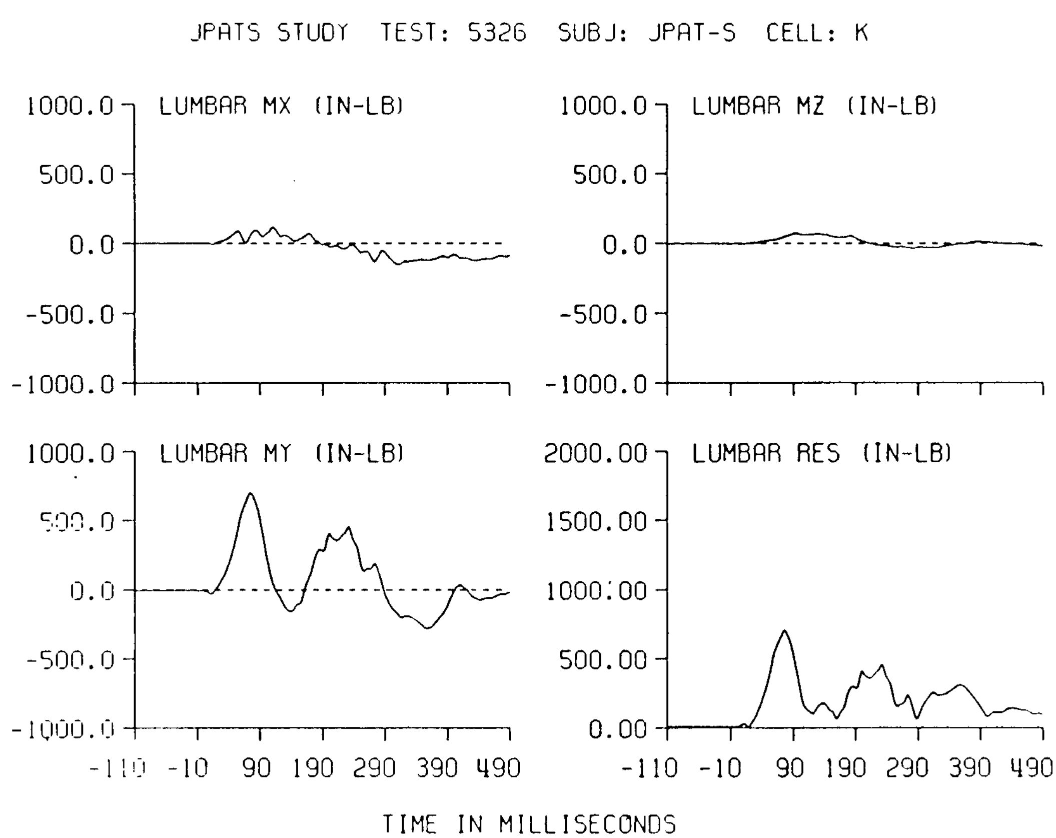
TIME IN MILLISECONDS

JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K

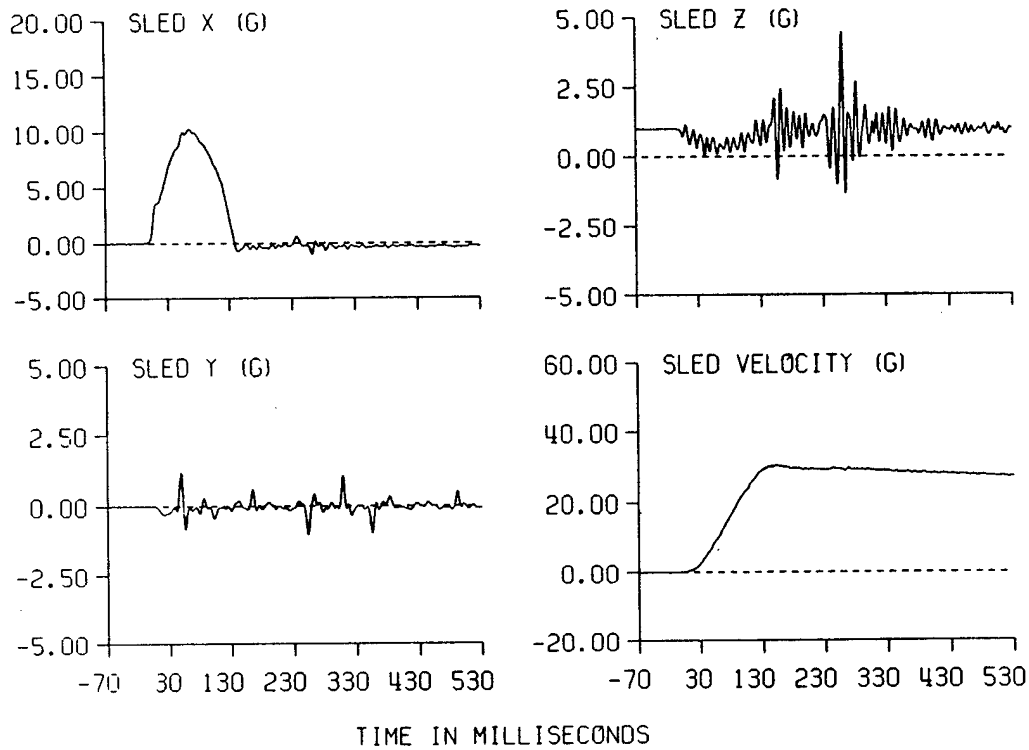


TIME IN MILLISECONDS

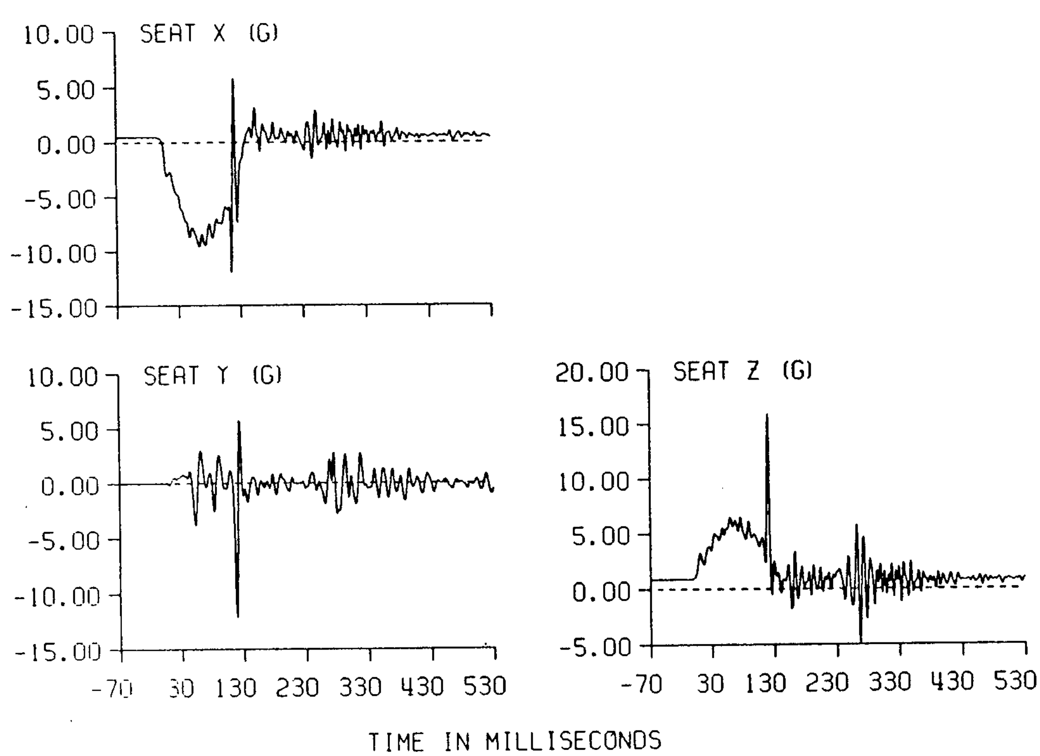

JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K
LUMBAR X (LB)
LUMBAR Z (LB)
LUMBAR Y (LB)
LUMBAR RES (LB)
200.00
100.00
0.00
-100.00
1500.00
1000.00
500.00
-500.00
2000.00
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS


JPATS STUDY TEST: 5326 SUBJ: JPAT-S CELL: K
LUMBAR MX (IN-LB)
LUMBAR MZ (IN-LB)
LUMBAR MY (IN-LB)
LUMBAR RES (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
2000.00
1500.00
1000.00
500.00
0.00
-110 -10 90 190 290 390 490
TIME IN MILLISECONDS

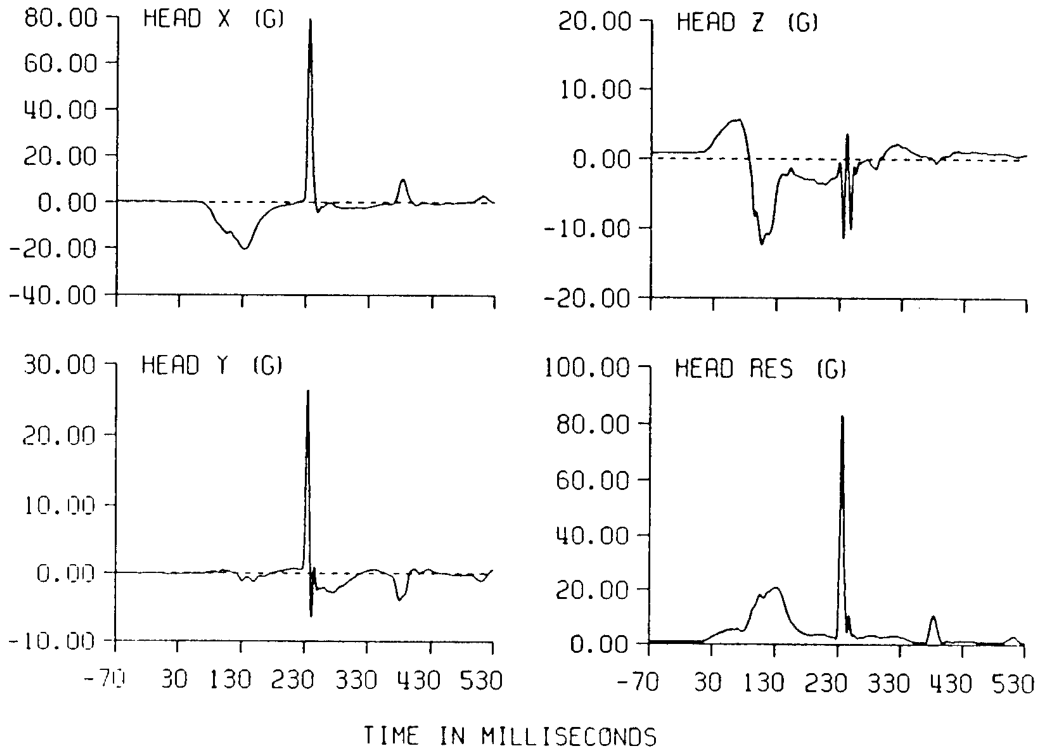
JPATS -GX STUDY TEST: 5315 SUBJ: JPAT-L CELL: K



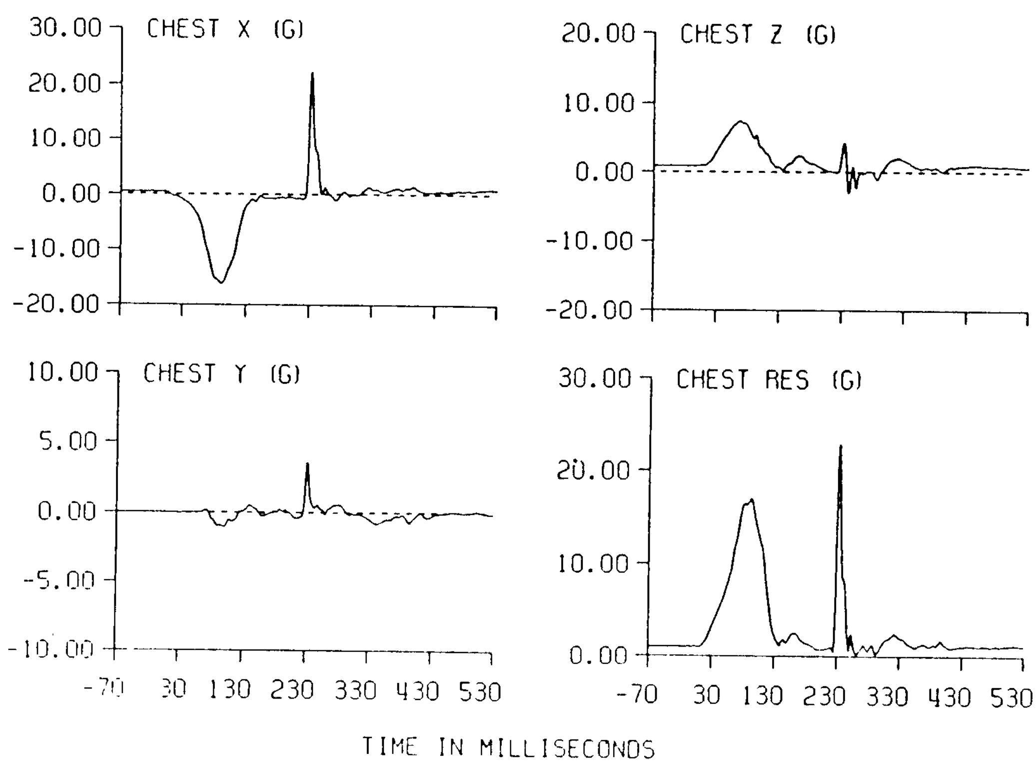
JPATS -GX STUDY TEST: 5315 SUBJ: JPAT-L CELL: K

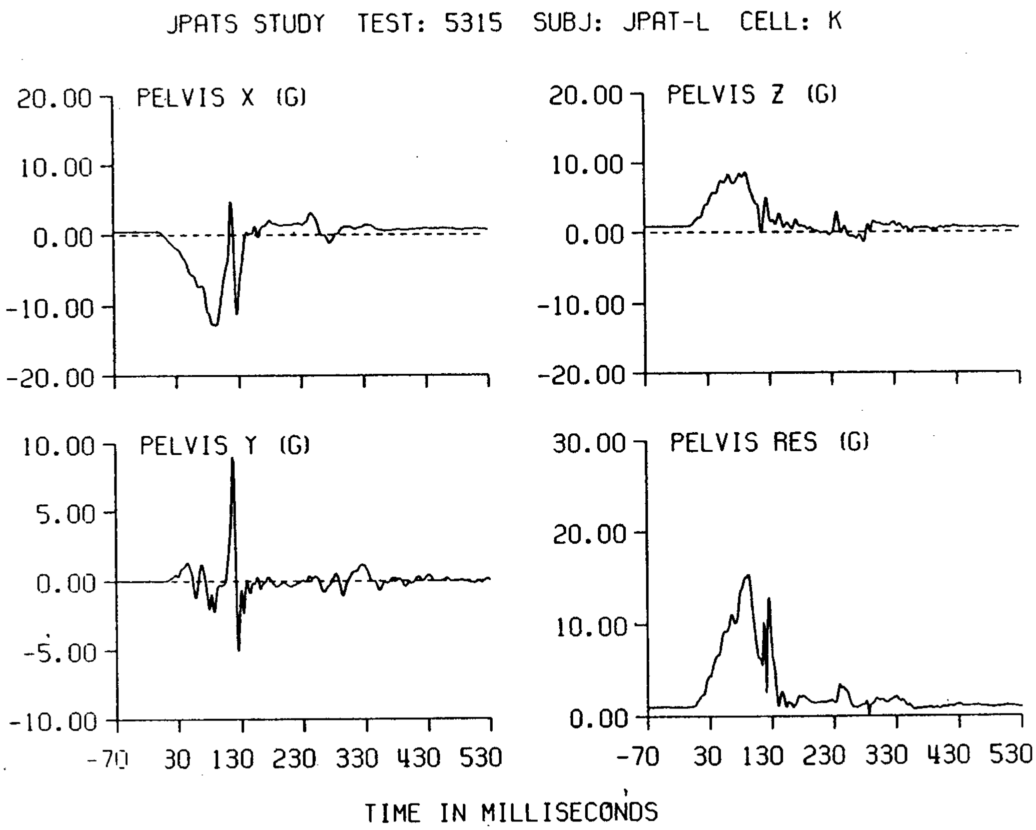


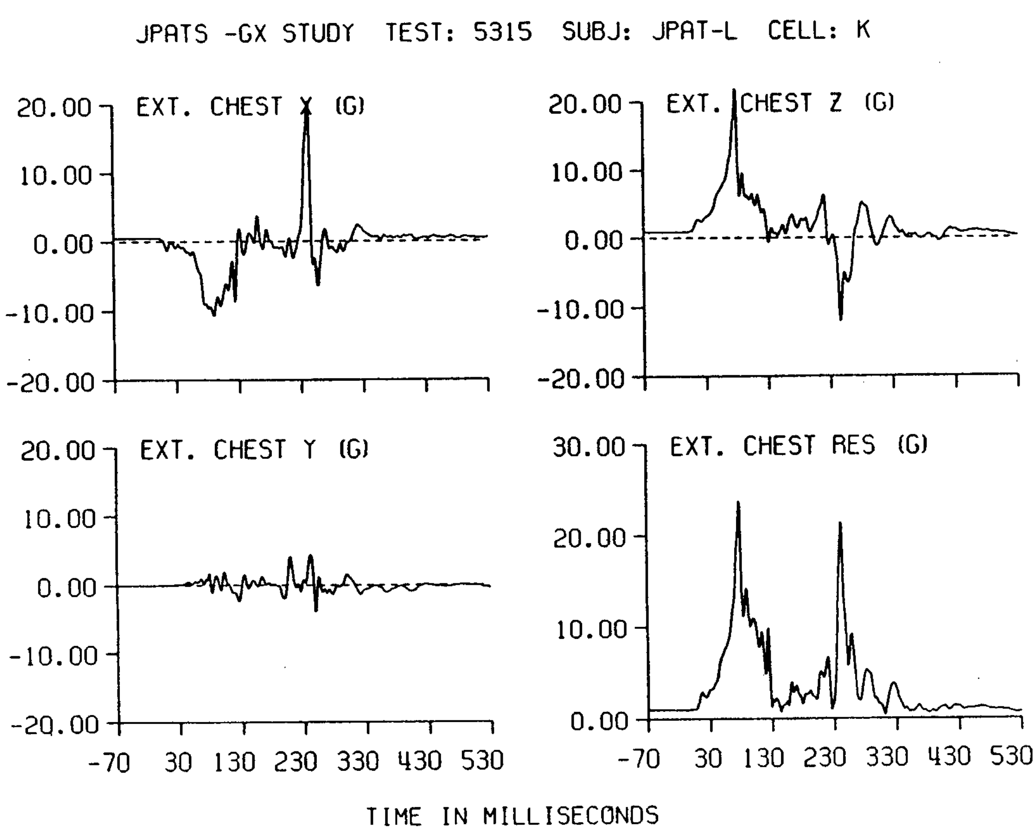
JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K

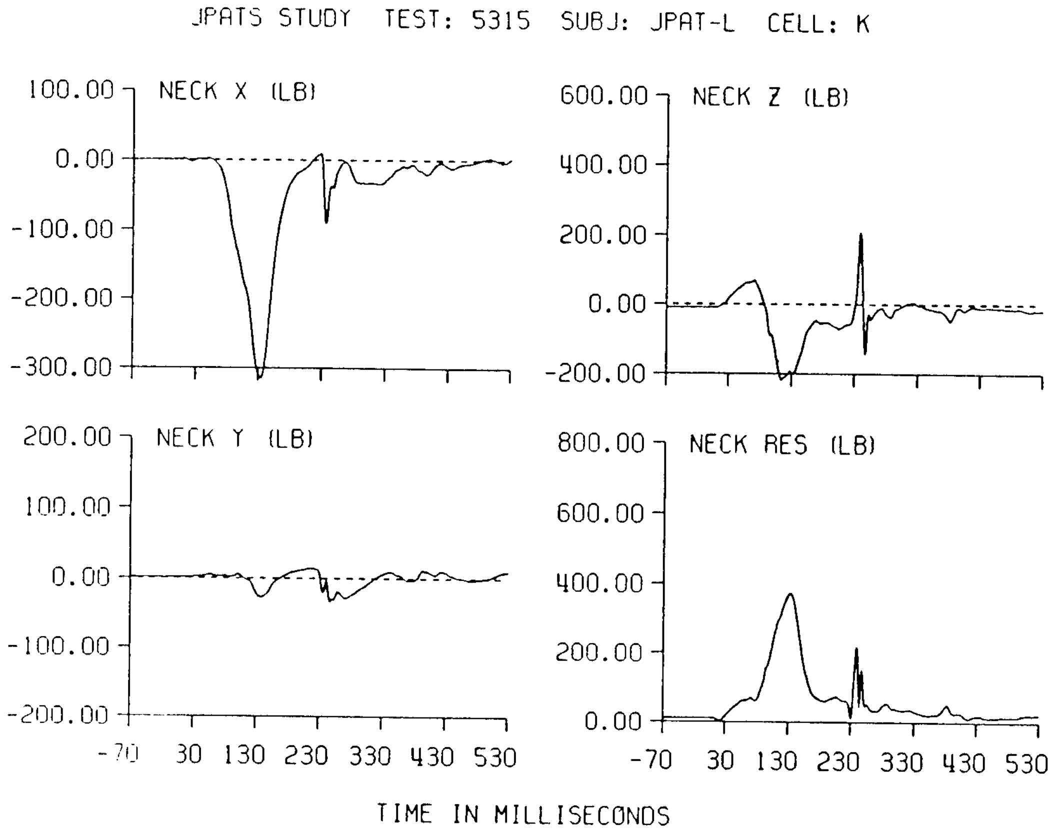


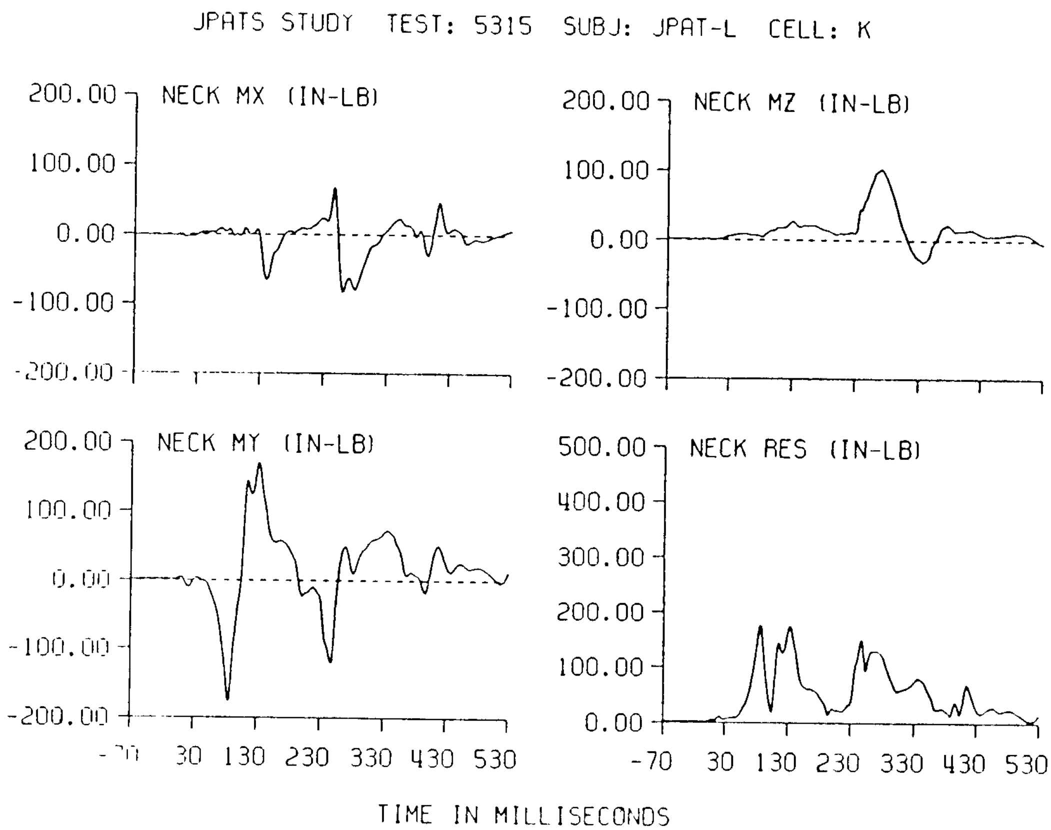
JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K



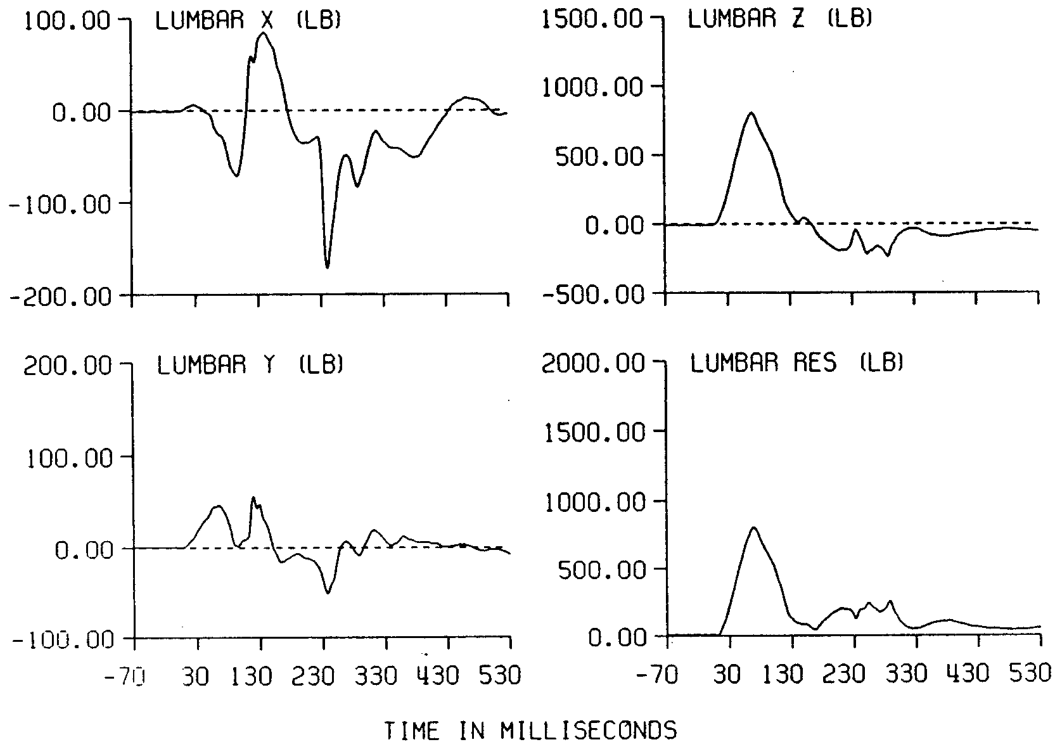

JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K
PELVIS X (G)
PELVIS Z (G)
PELVIS Y (G)
PELVIS RES (G)
20.00
10.00
0.00
-10.00
-20.00
5.00
-5.00
30.00
-70
30
130
230
330
430
530
TIME IN MILLISECONDS


JPATS -GX STUDY TEST: 5315 SUBJ: JPAT-L CELL: K
EXT. CHEST X (G)
EXT. CHEST Z (G)
EXT. CHEST Y (G)
EXT. CHEST RES (G)
20.00
10.00
0.00
-10.00
-20.00
30.00
-70
30
130
230
330
430
530
TIME IN MILLISECONDS

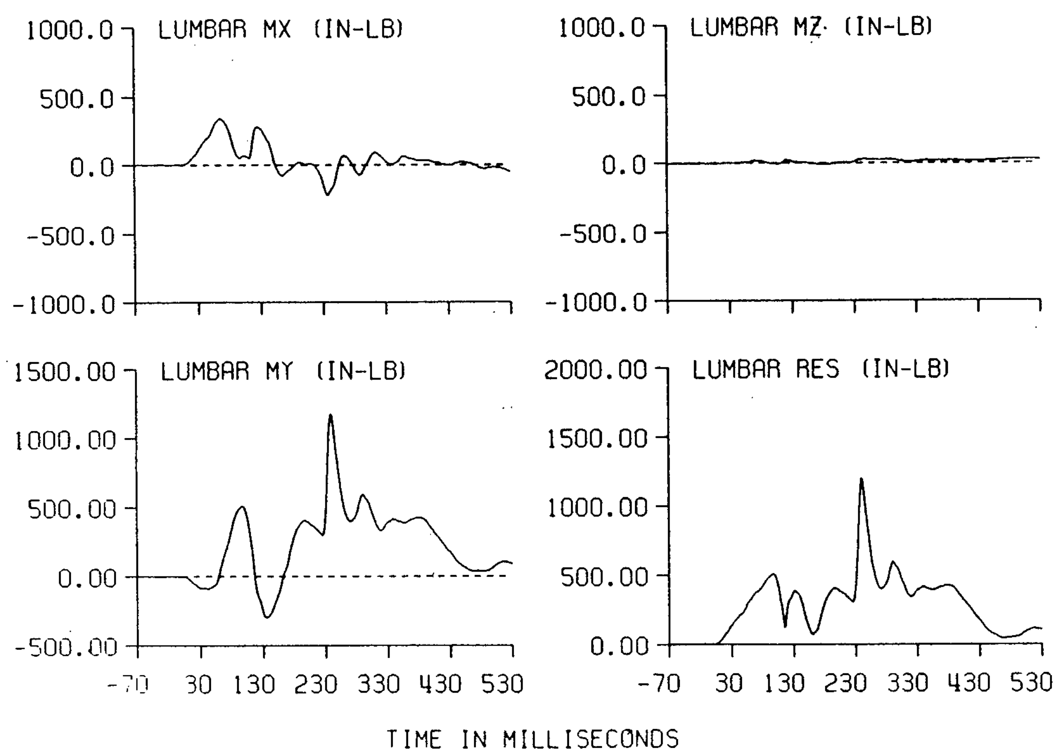

JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
100.00
0.00
-100.00
-200.00
-300.00
600.00
400.00
200.00
0.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
800.00
600.00
400.00
200.00
0.00
-70 30 130 230 330 430 530
-70 30 130 230 330 430 530
TIME IN MILLISECONDS


JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
200.00
100.00
0.00
-100.00
-200.00
500.00
400.00
300.00
200.00
100.00
0.00
-70 30 130 230 330 430 530
-70 30 130 230 330 430 530
TIME IN MILLISECONDS

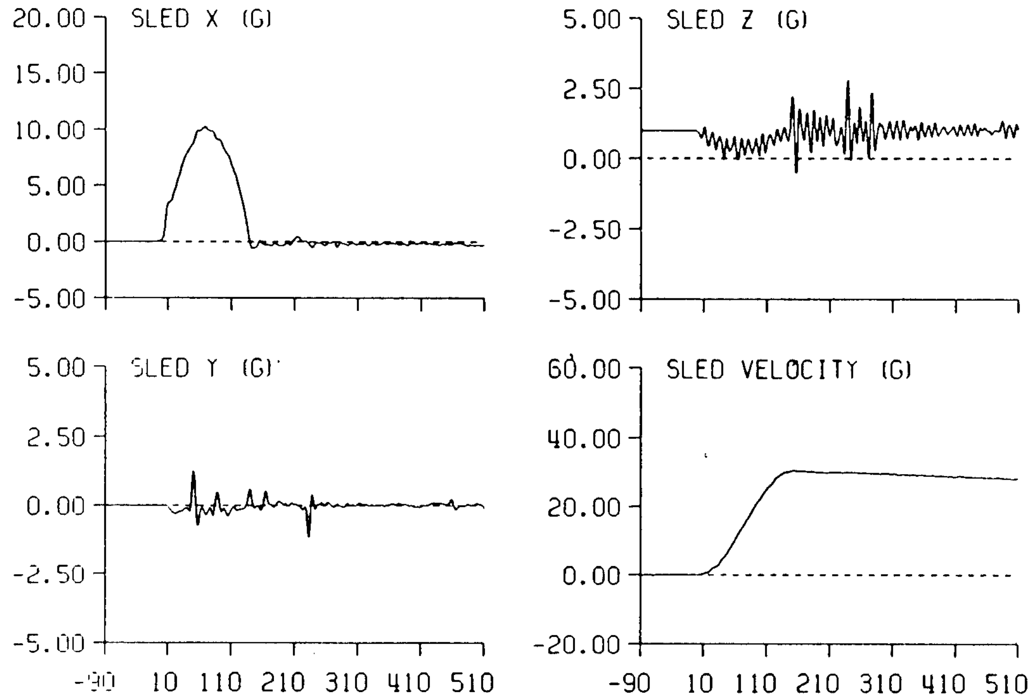
JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K



JPATS STUDY TEST: 5315 SUBJ: JPAT-L CELL: K

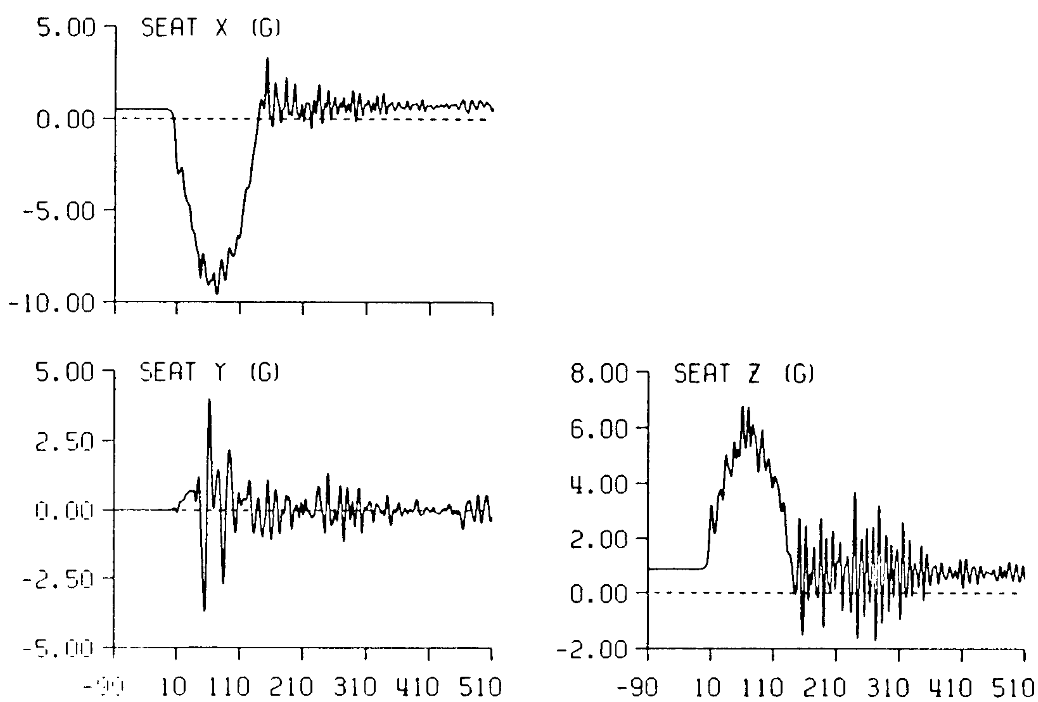


JPATS -GX STUDY TEST: 5319 SUBJ: ADAM-L CELL: K



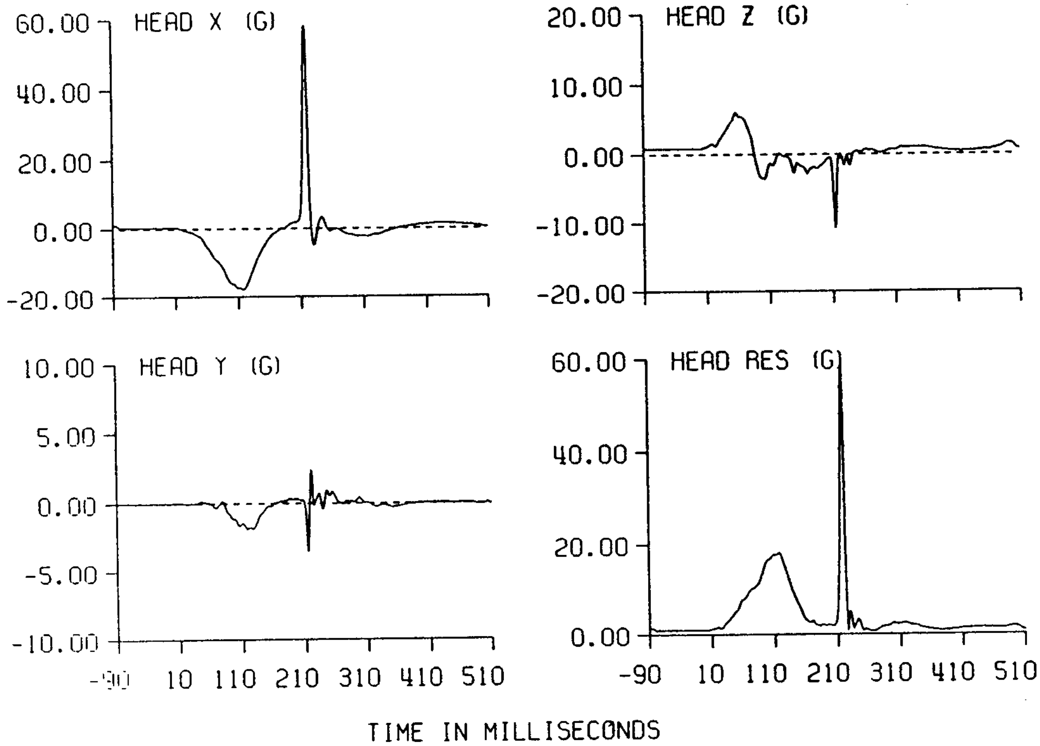
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5319 SUBJ: ADAM-L CELL: K

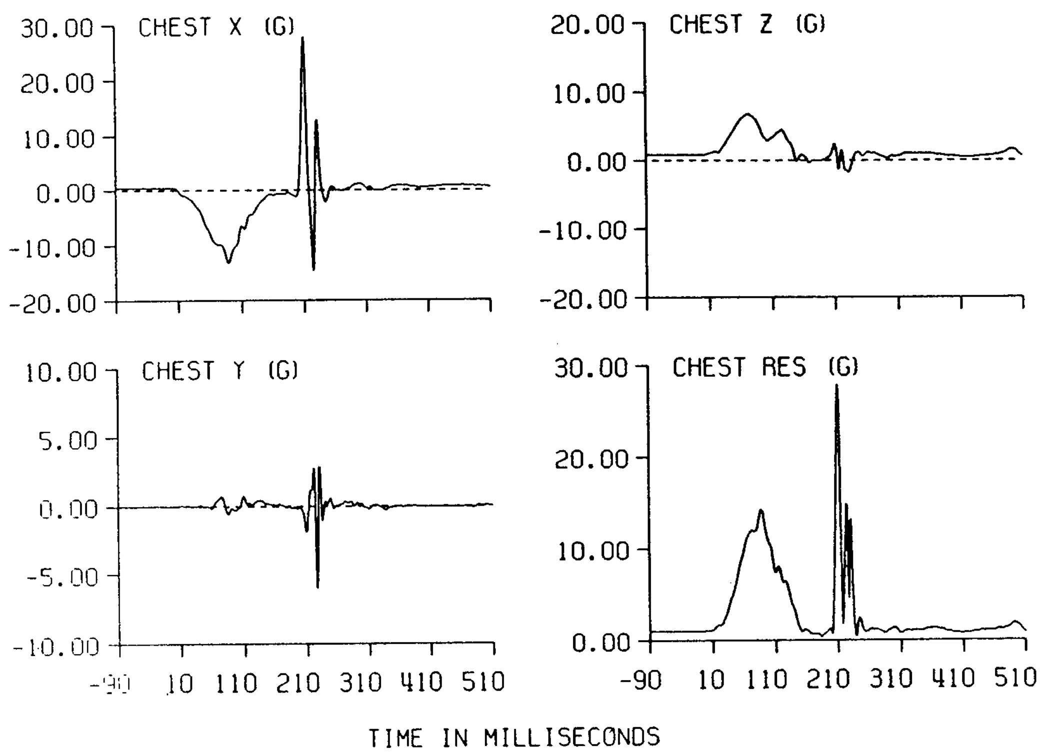


TIME IN MILLISECONDS

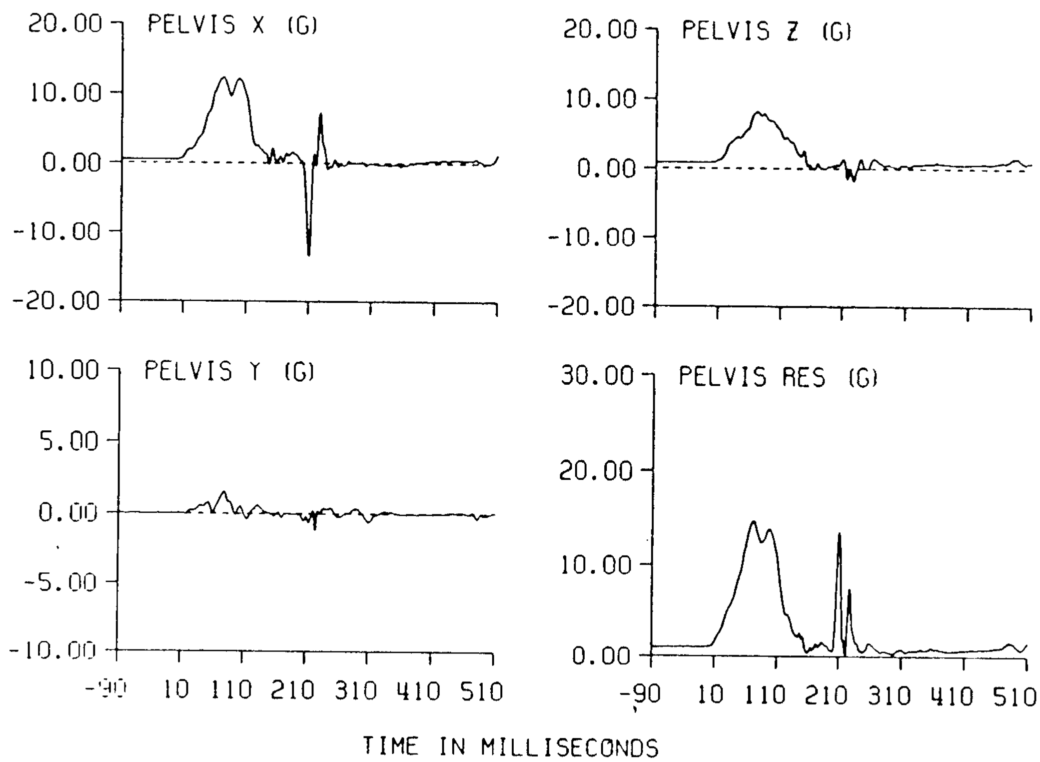
JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K



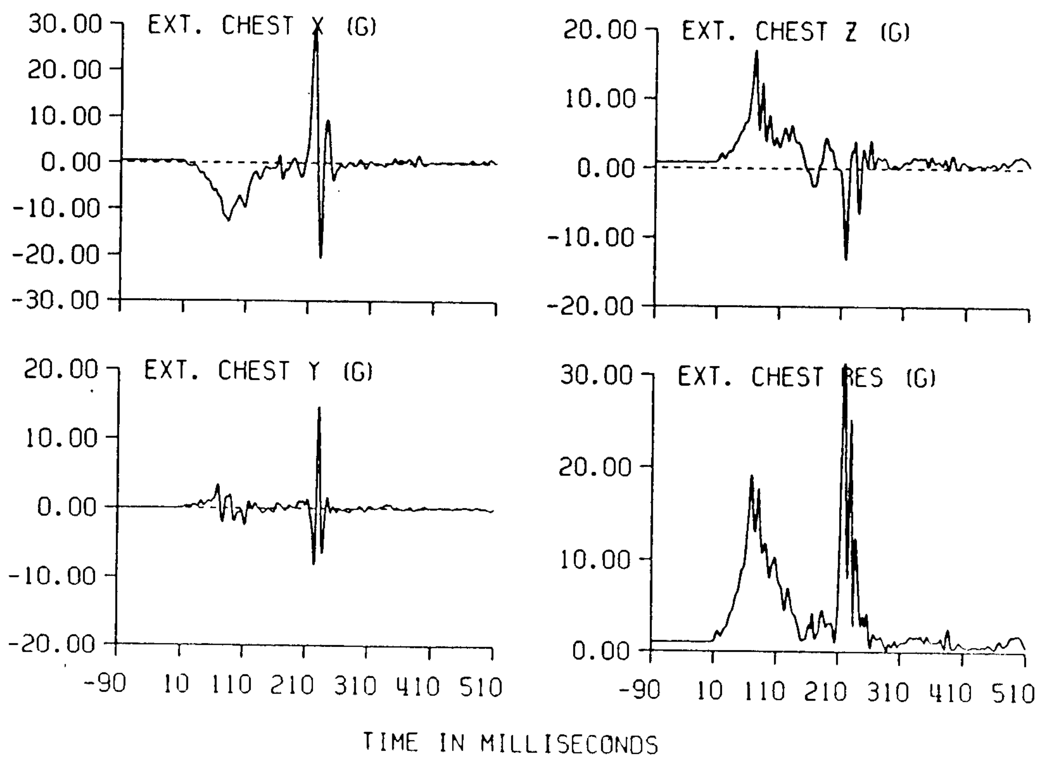
JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K

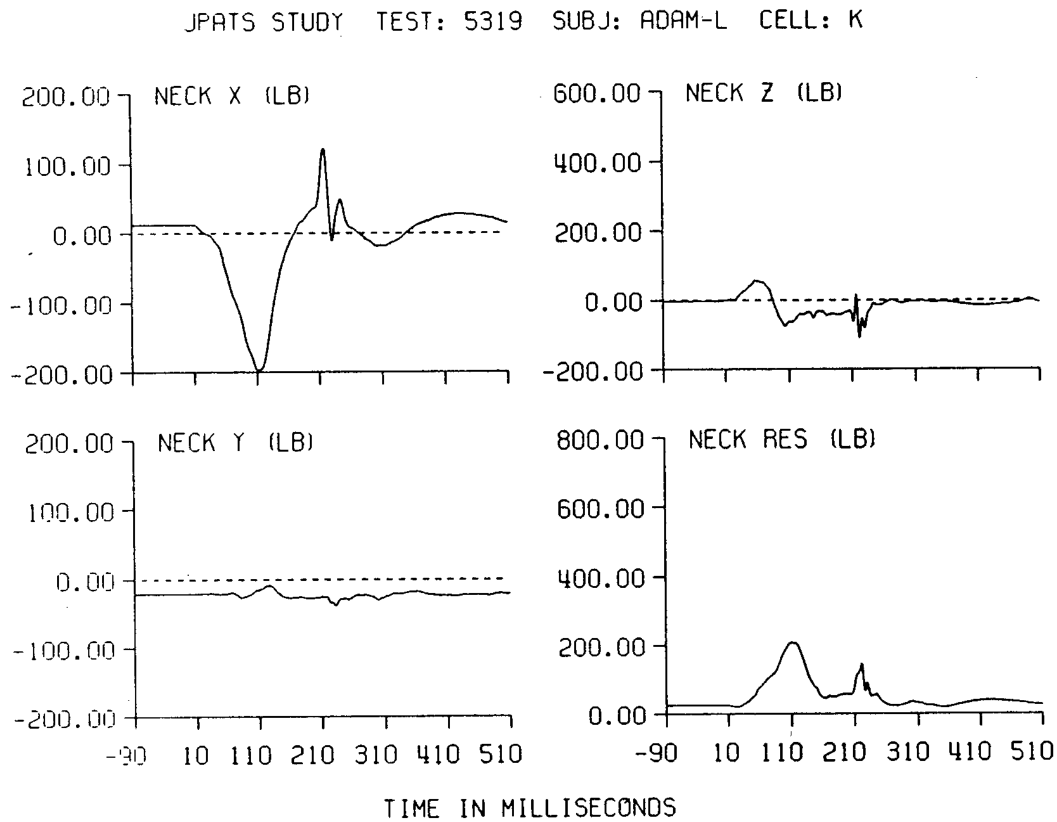


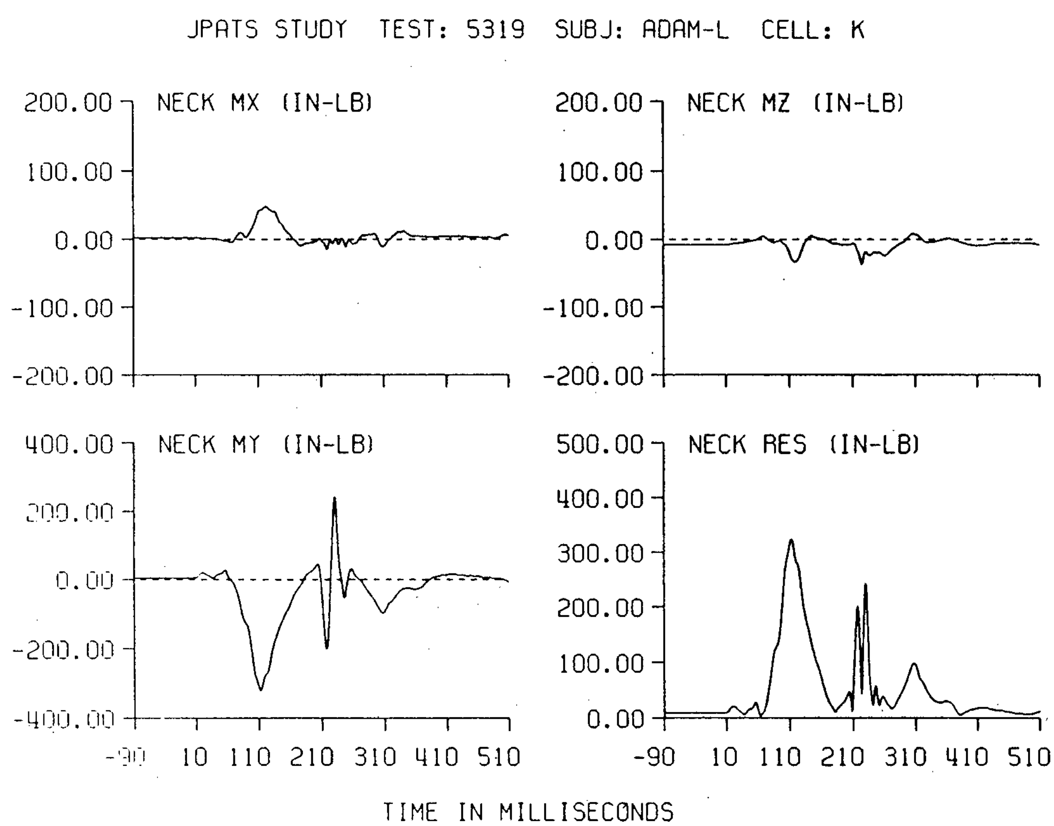
JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K



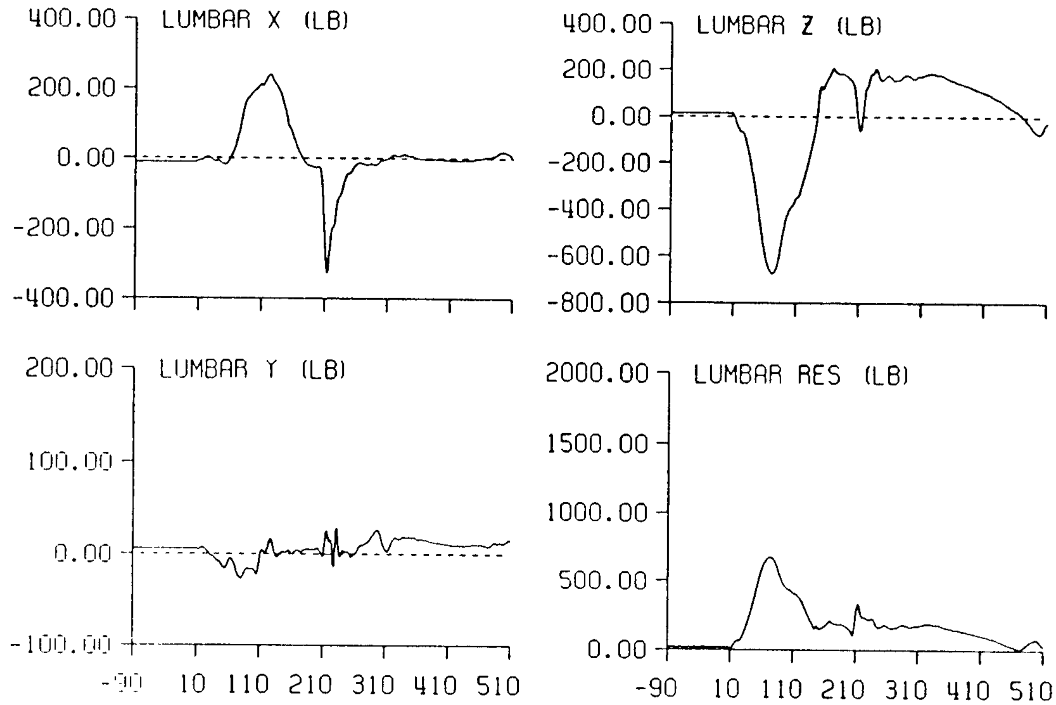
JPATS -GX STUDY TEST: 5319 SUBJ: ADAM-L CELL: K




JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
TIME IN MILLISECONDS

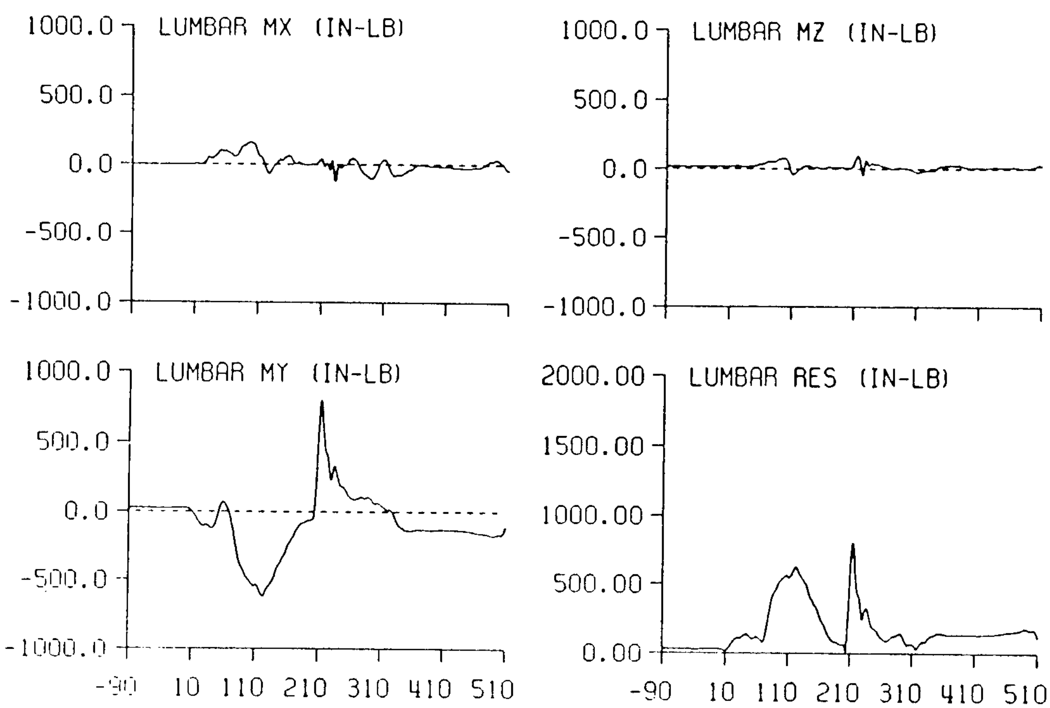

JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
TIME IN MILLISECONDS

JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K

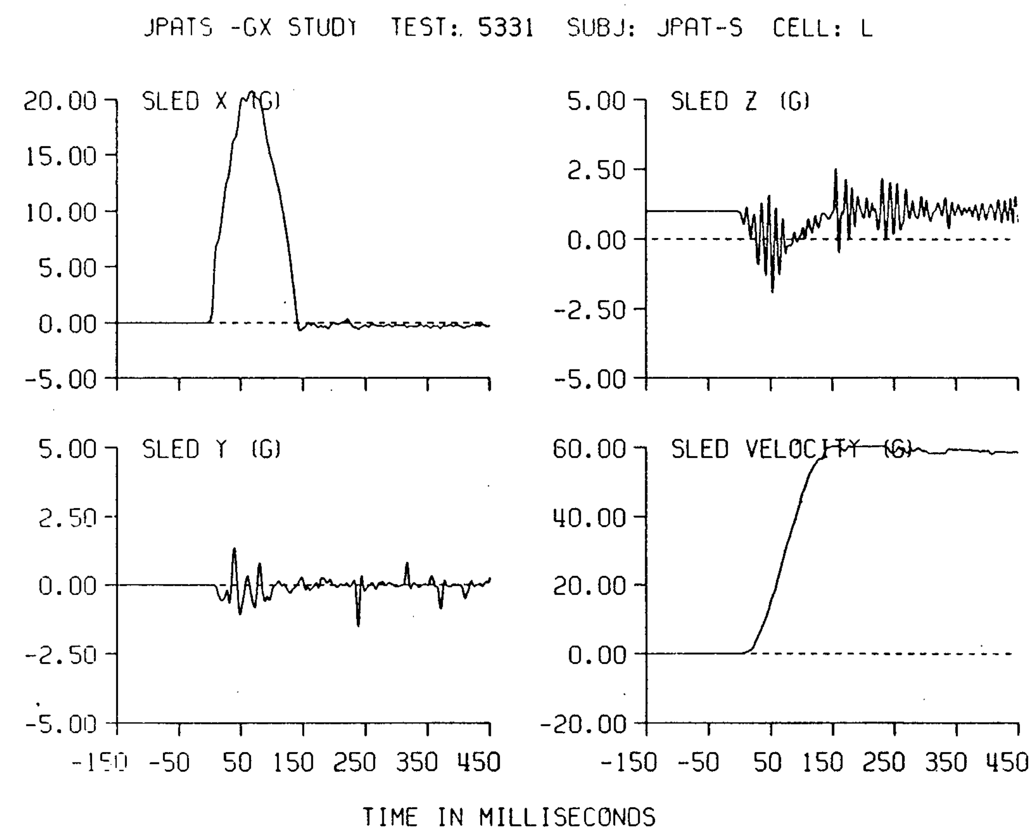


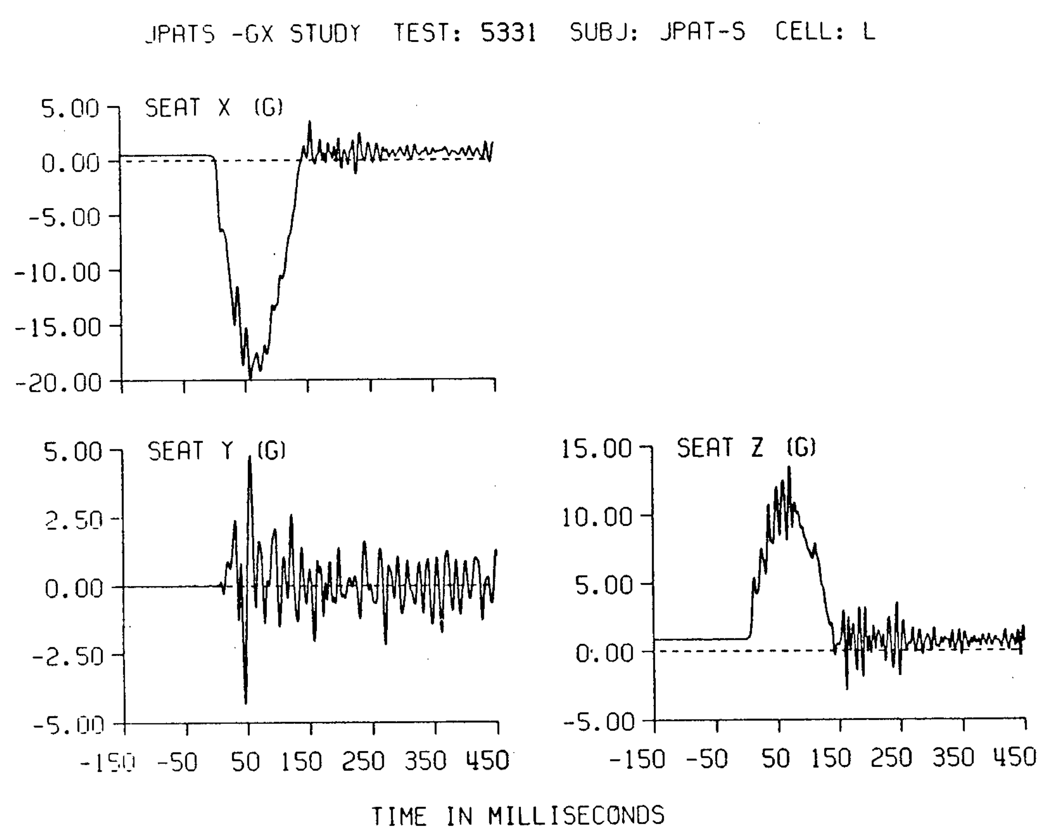
TIME IN MILLISECONDS

JPATS STUDY TEST: 5319 SUBJ: ADAM-L CELL: K

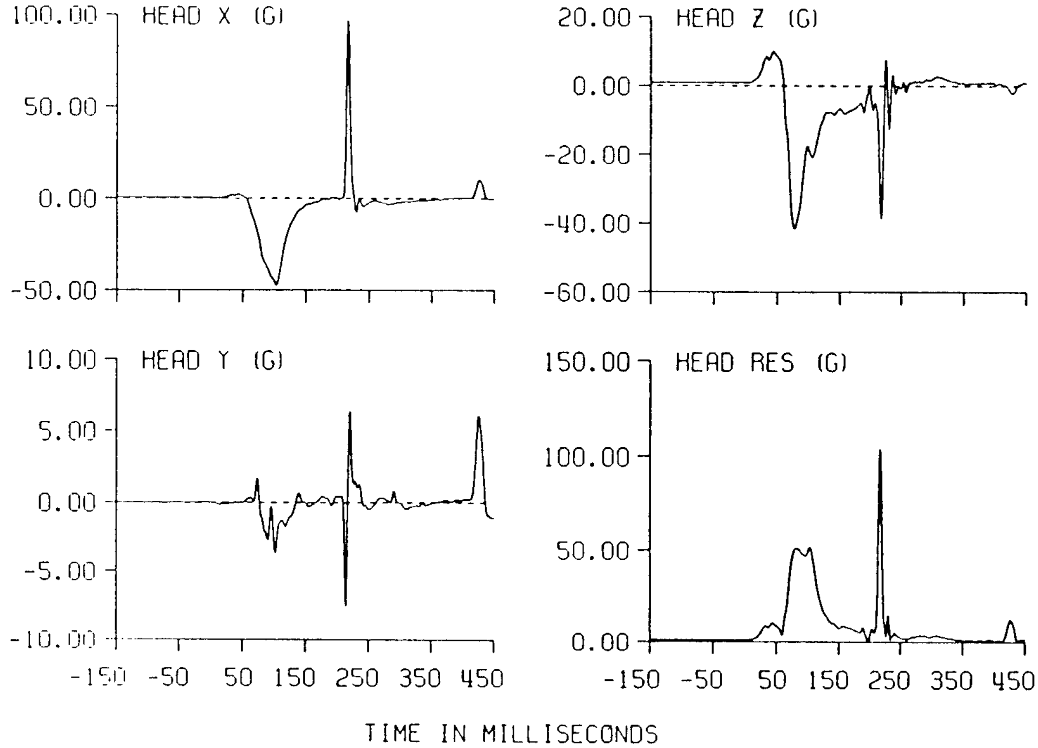


TIME IN MILLISECONDS

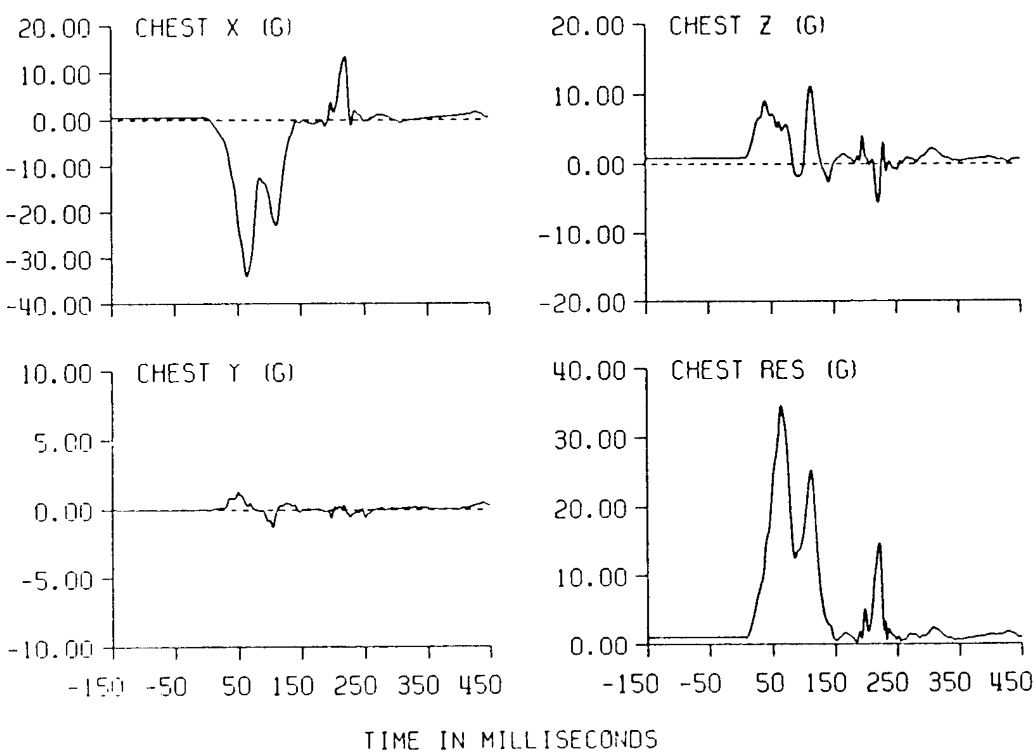

JPATS -GX STUDY TEST: 5331 SUBJ: JPAT-S CELL: L
SLED X (G)
SLED Z (G)
SLED Y (G)
SLED VELOCITY (G)
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS


JPATS -GX STUDY TEST: 5331 SUBJ: JPAT-S CELL: L
SEAT X (G)
SEAT Y (G)
SEAT Z (G)
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS

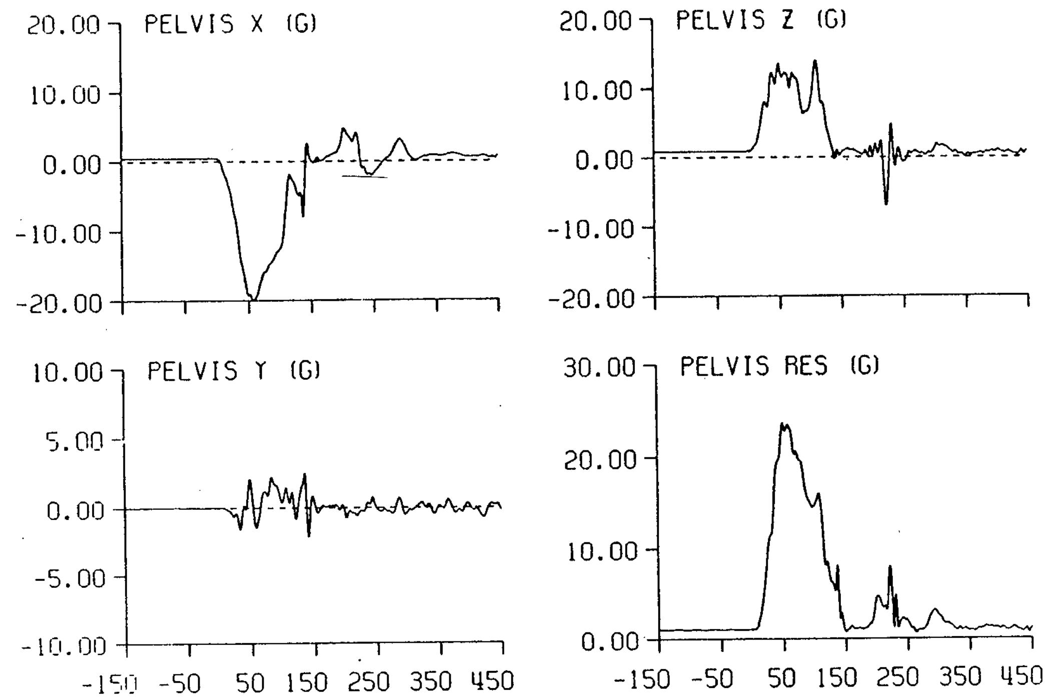
JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L



JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L

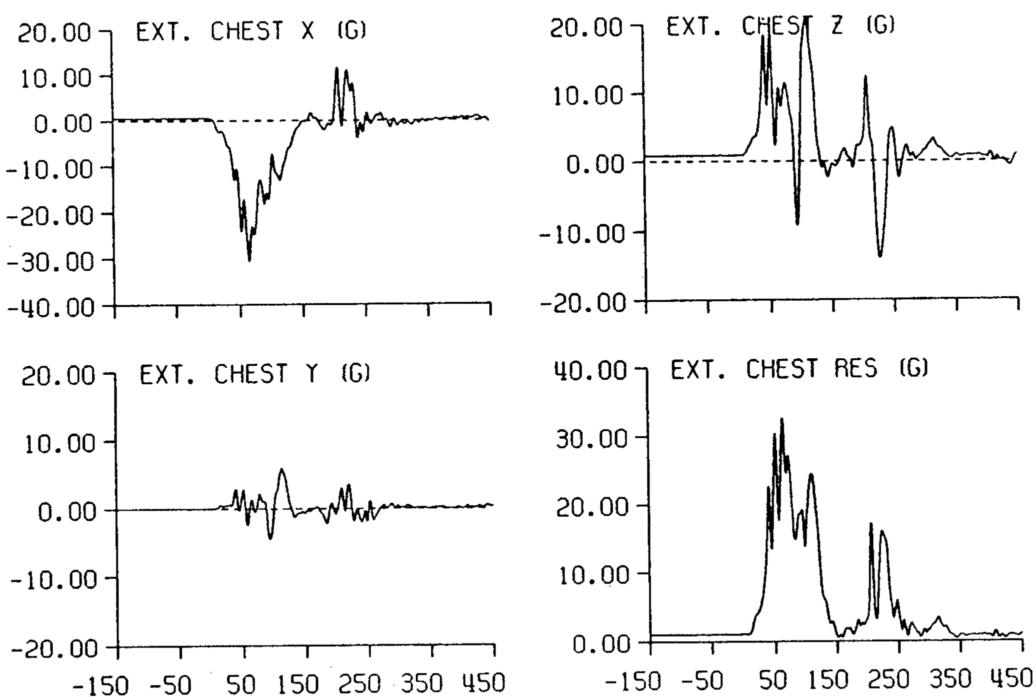


JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L

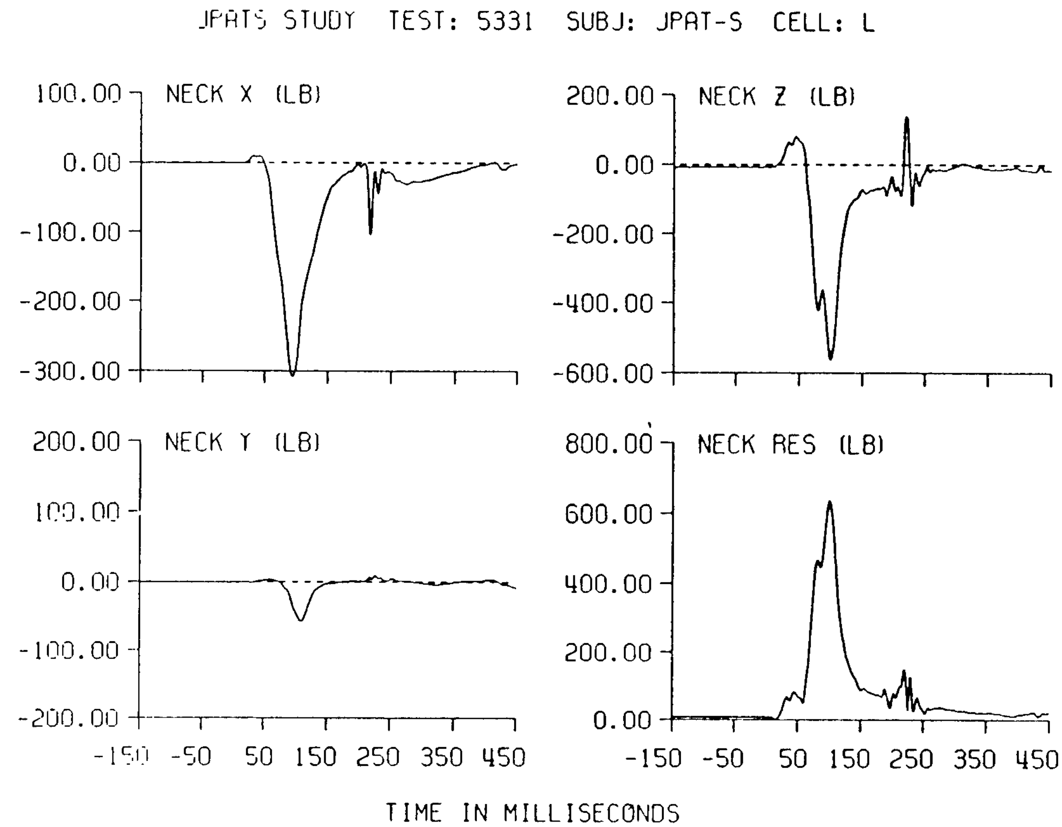


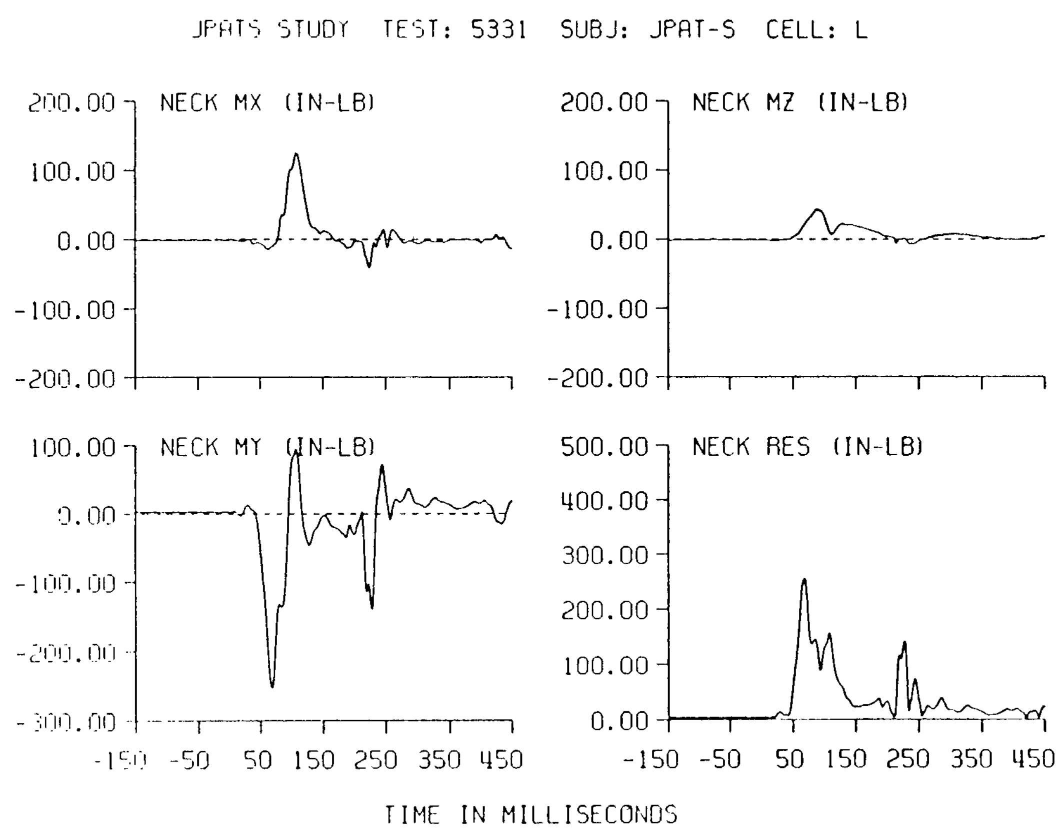
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5331 SUBJ: JPAT-S CELL: L

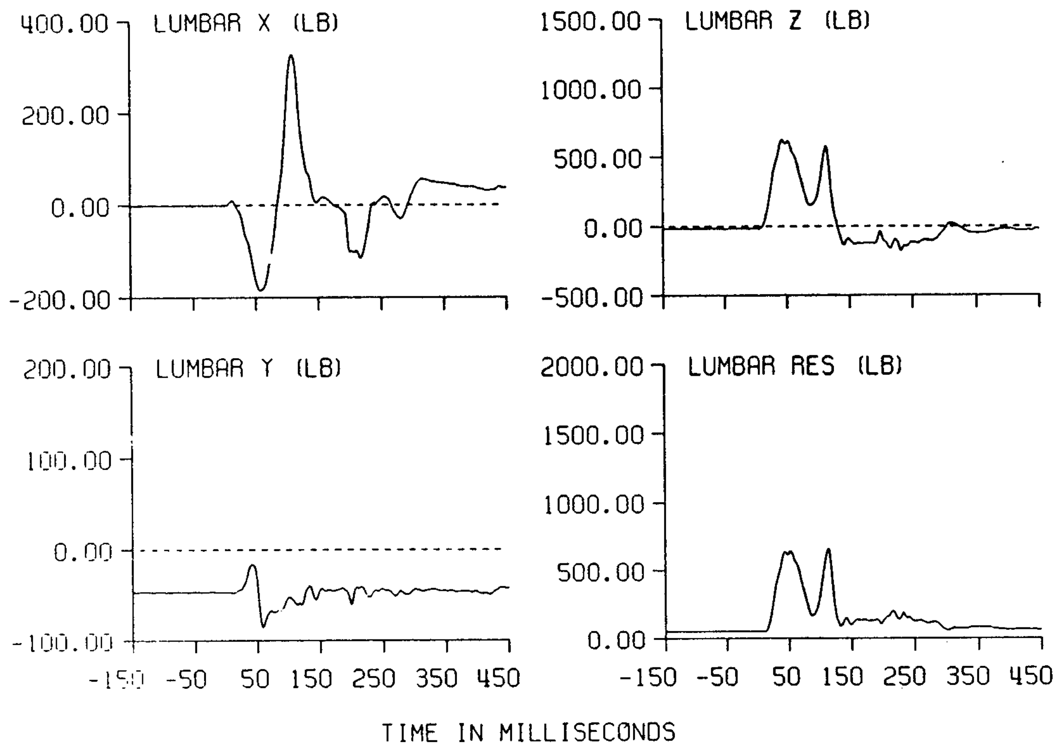


TIME IN MILLISECONDS

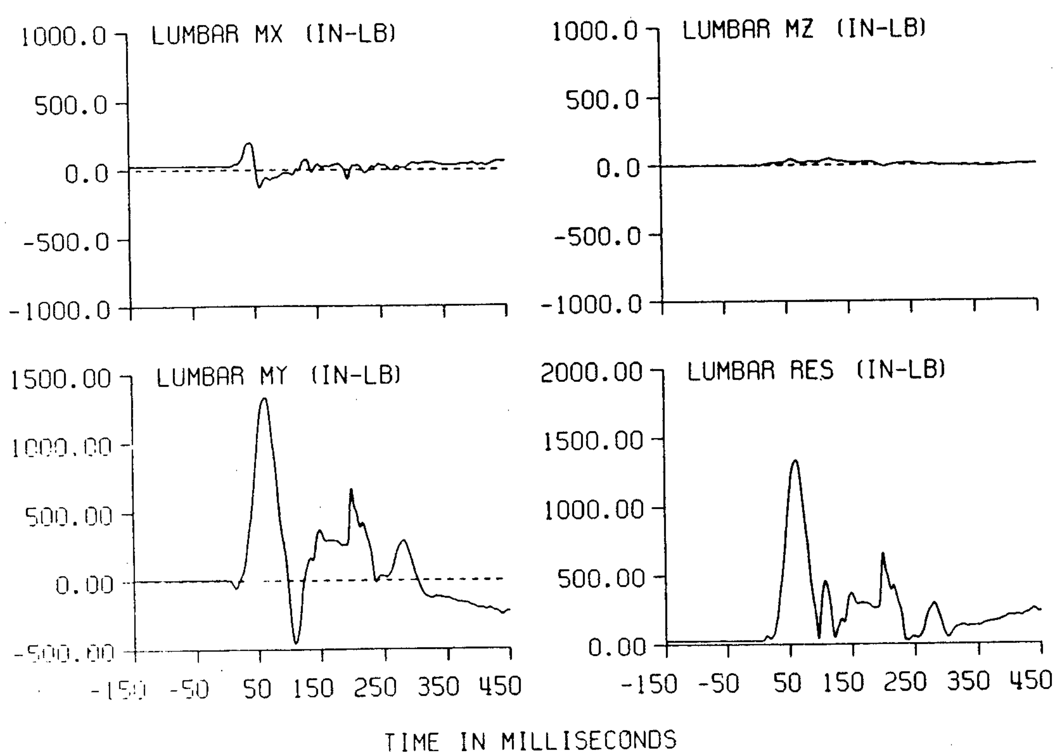

JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L
NECK X (LB)
NECK Z (LB)
NECK Y (LB)
NECK RES (LB)
TIME IN MILLISECONDS


JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L
NECK MX (IN-LB)
NECK MZ (IN-LB)
NECK MY (IN-LB)
NECK RES (IN-LB)
TIME IN MILLISECONDS

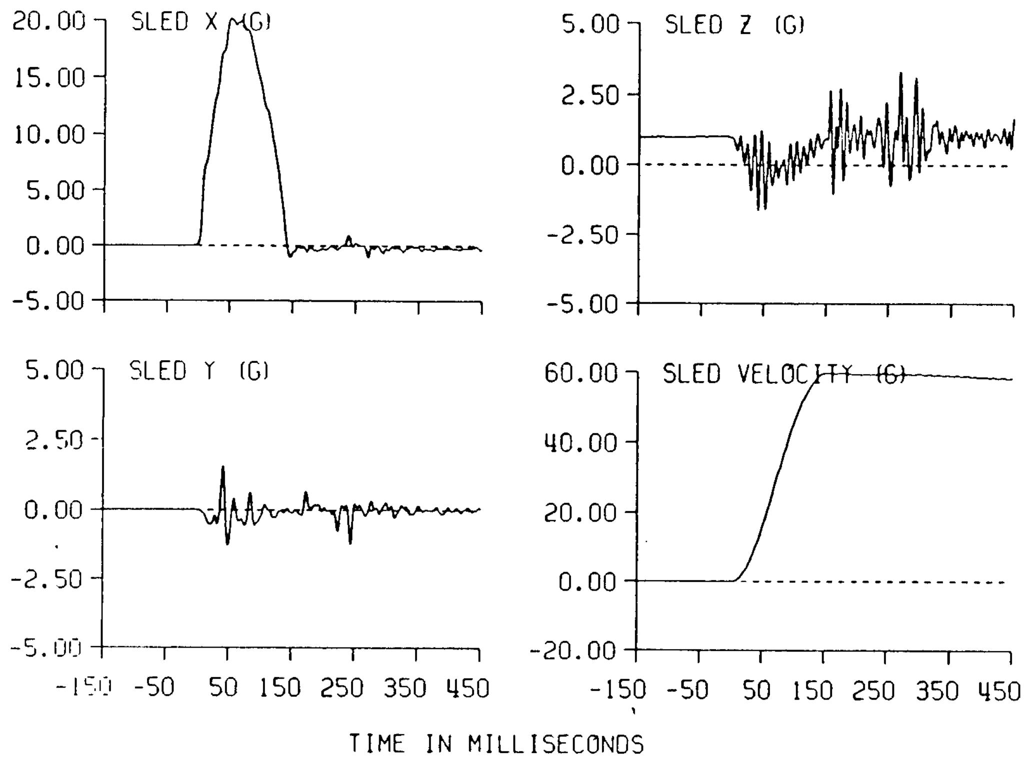
JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L



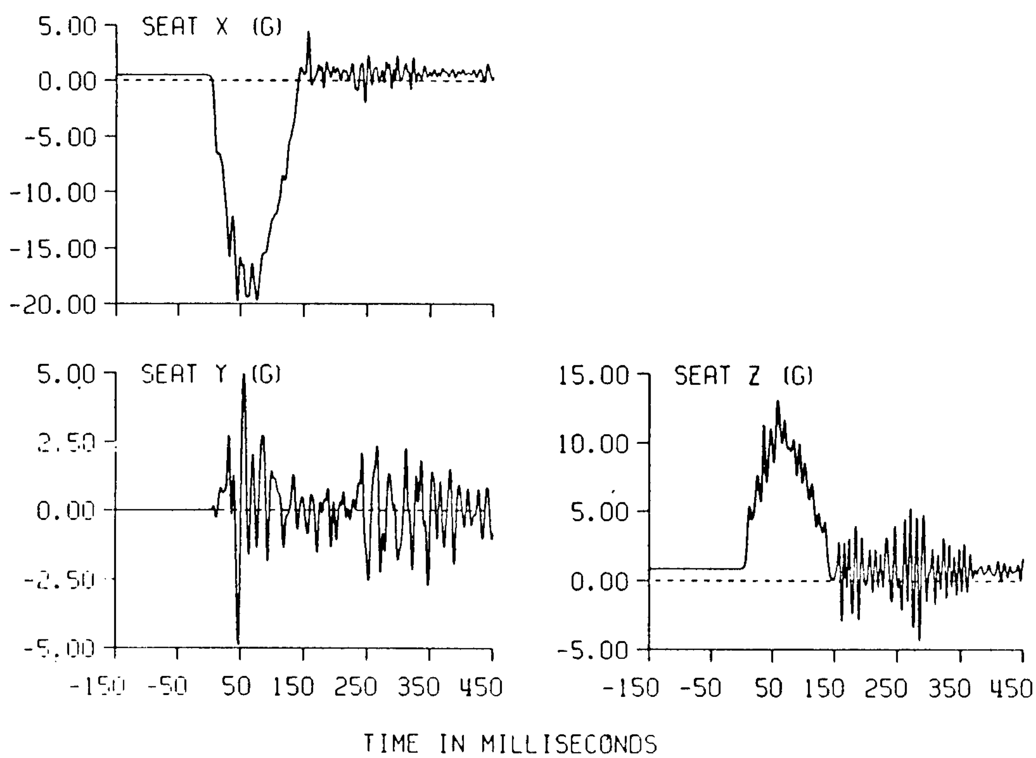
JPATS STUDY TEST: 5331 SUBJ: JPAT-S CELL: L



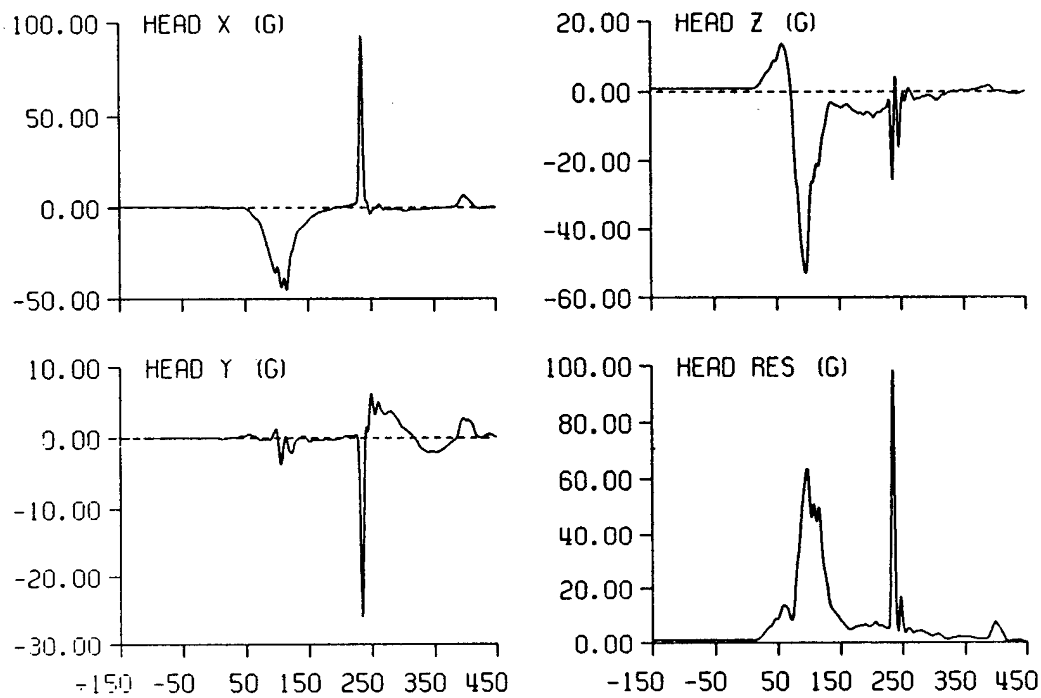
JPATS -GX STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



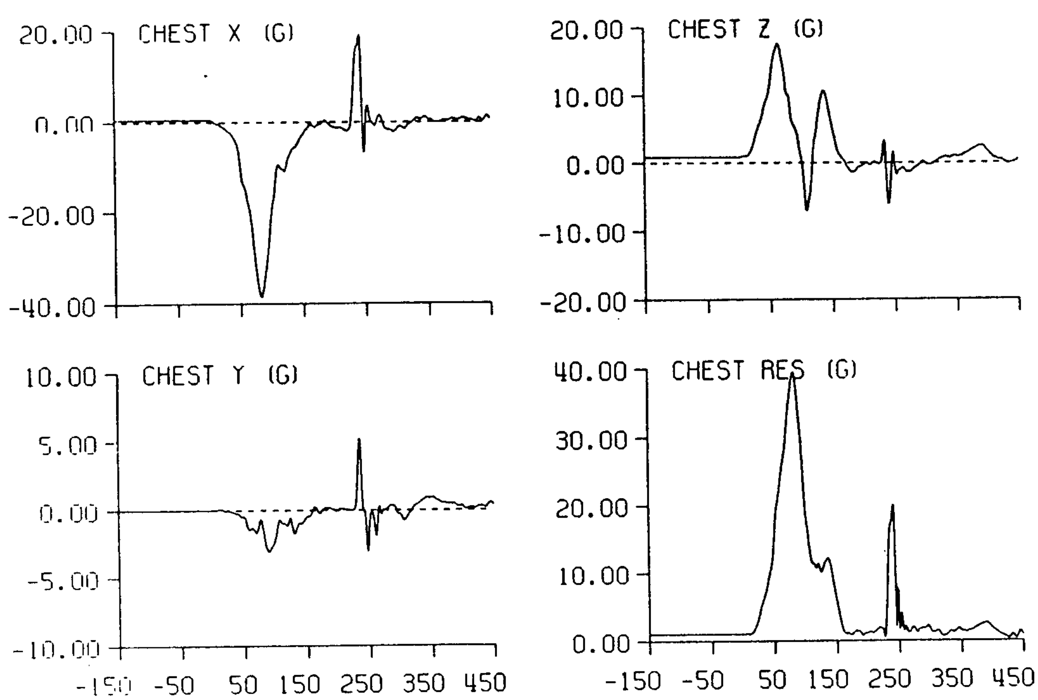
JPATS -GX STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



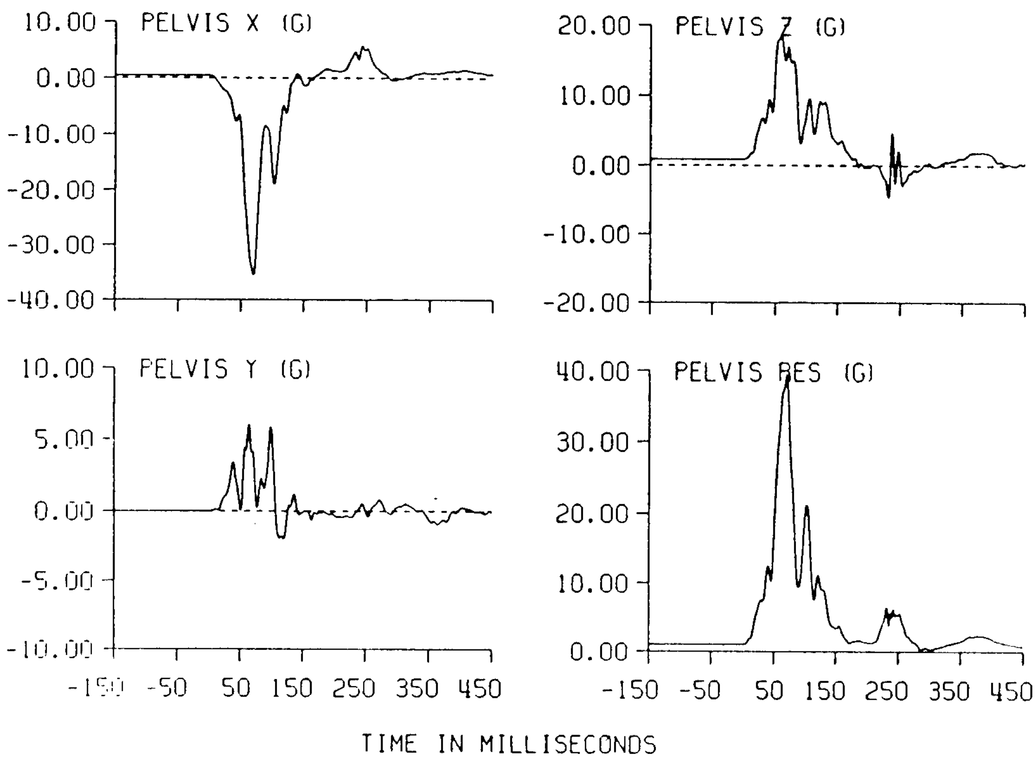
JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



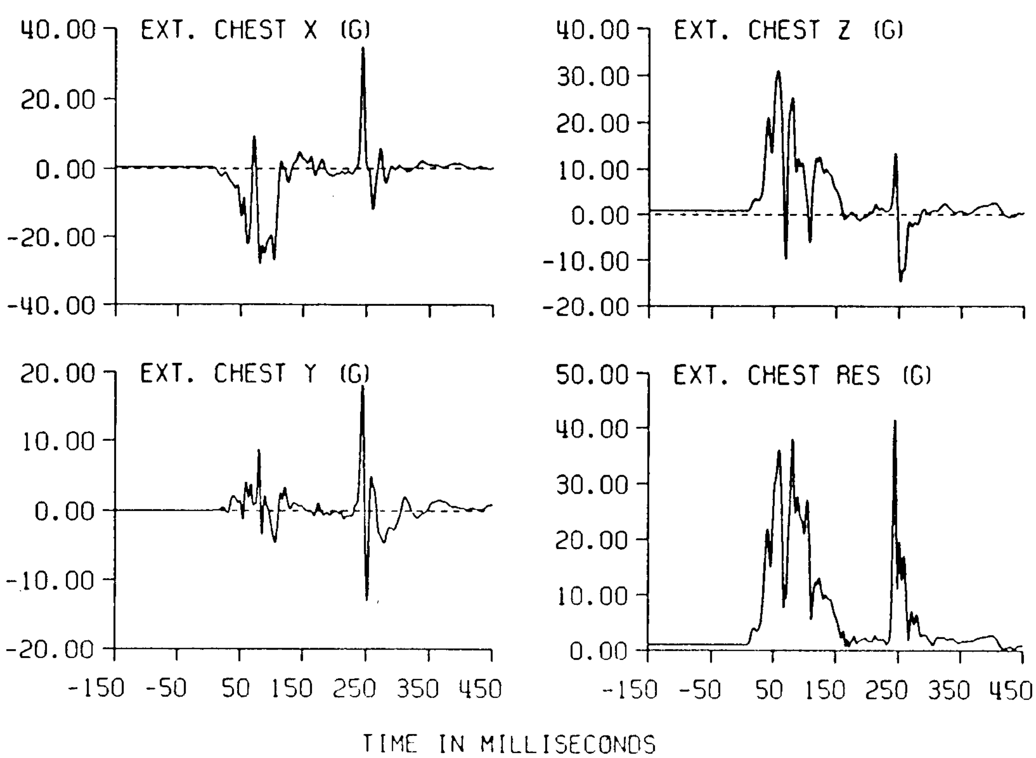
JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



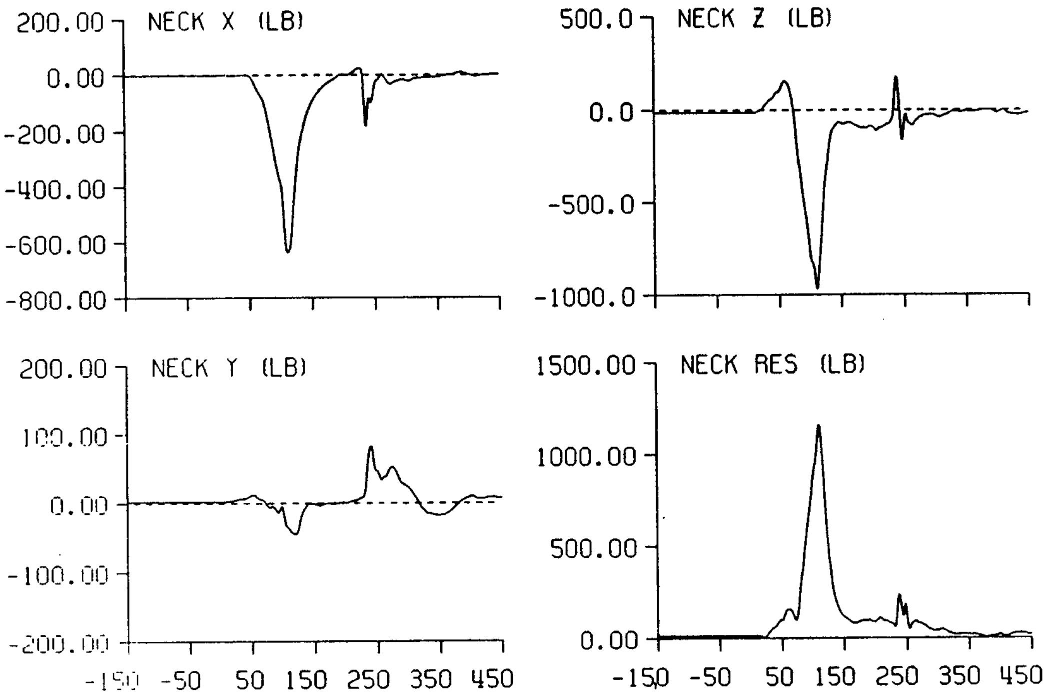
JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



JPATS -GX STUDY TEST: 5339 SUBJ: JPAT-L CELL: L

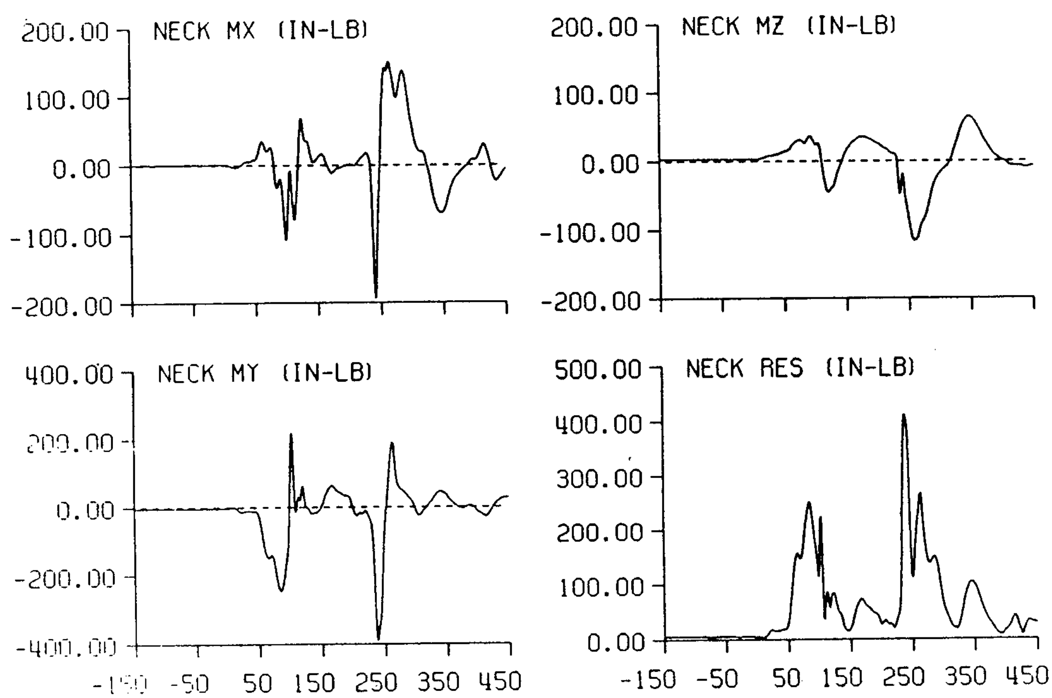


JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



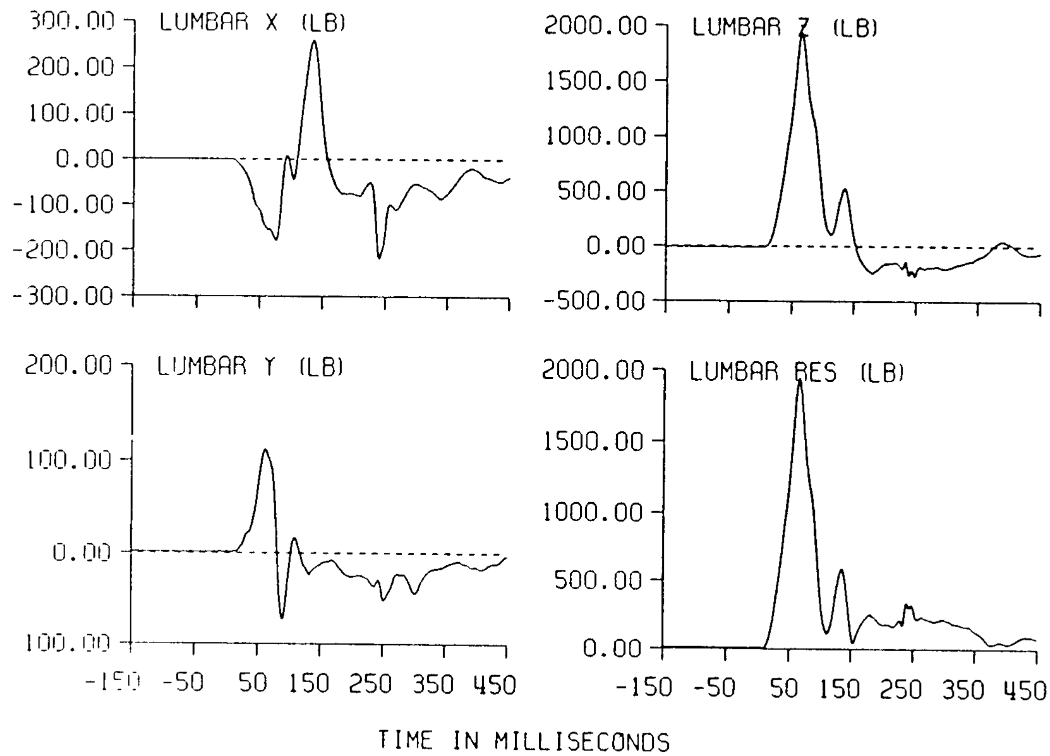
TIME IN MILLISECONDS

JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L

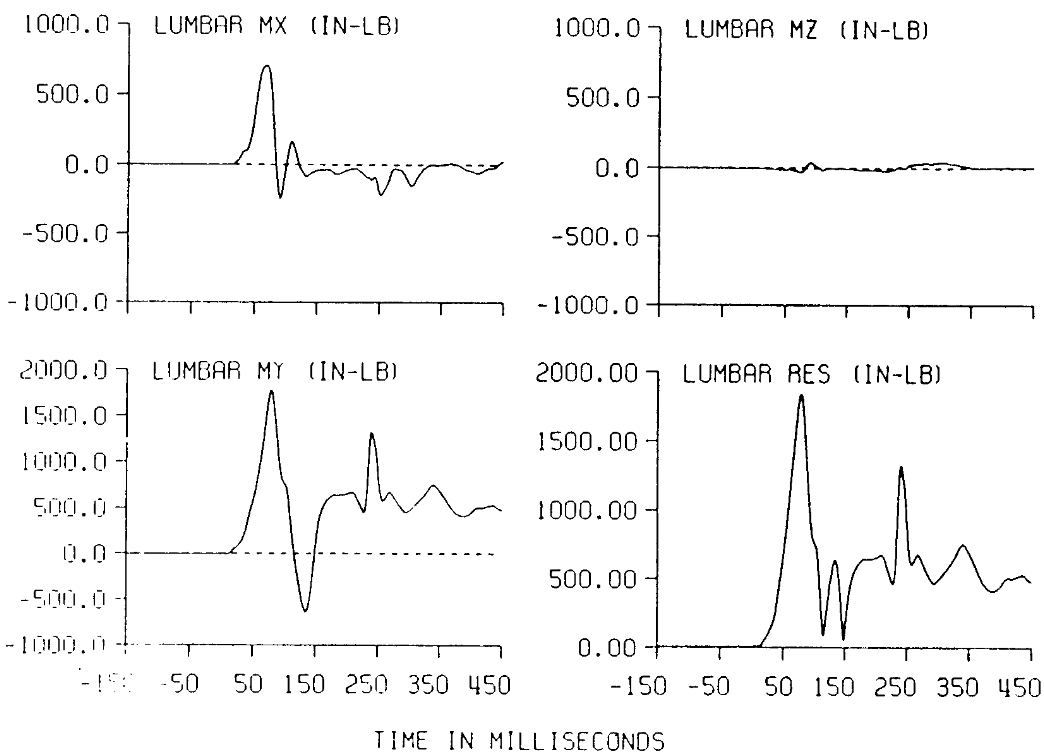


TIME IN MILLISECONDS

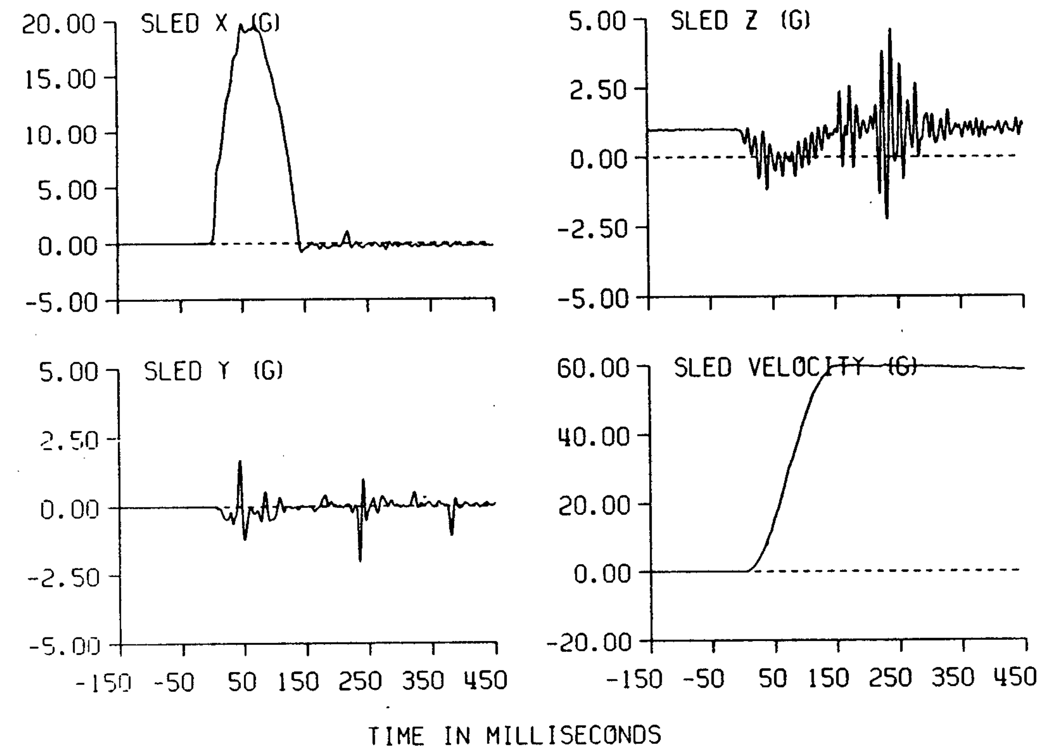
JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



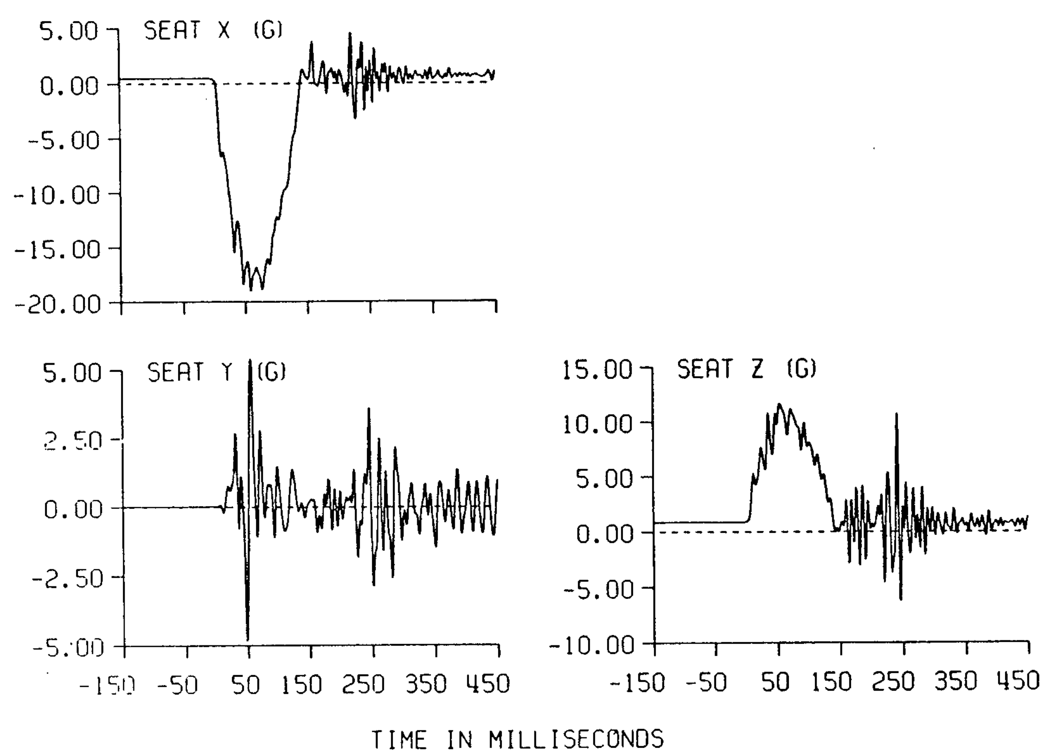
JPATS STUDY TEST: 5339 SUBJ: JPAT-L CELL: L



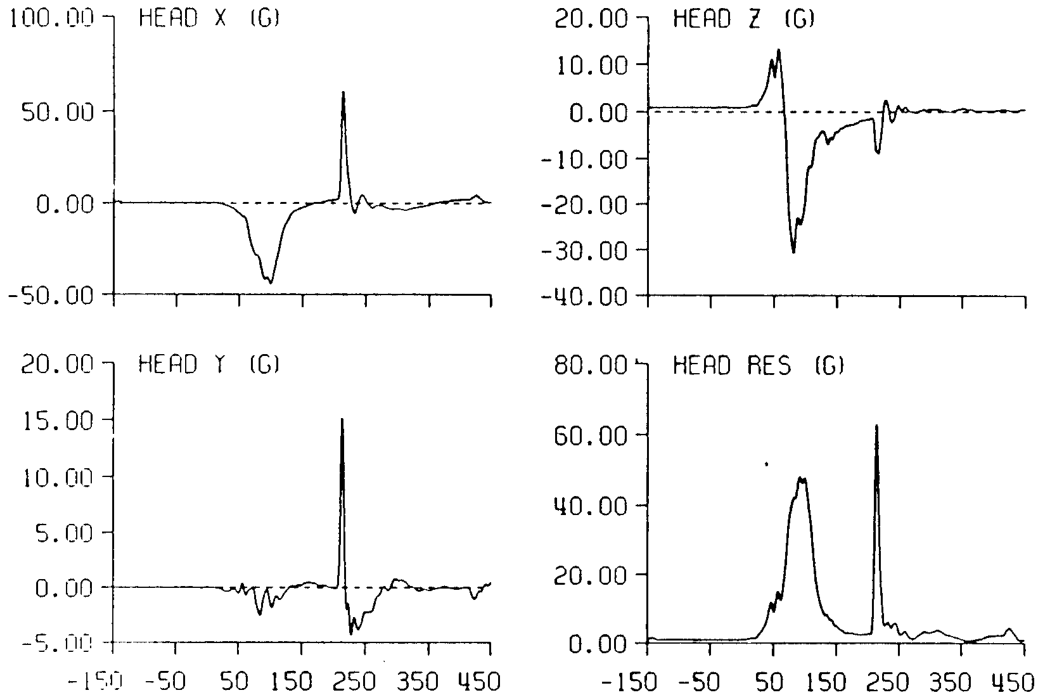
JPATS -GX STUDY TEST: 5336 SUBJ: ADAM-L CELL: L



JPATS -GX STUDY TEST: 5336 SUBJ: ADAM-L CELL: L

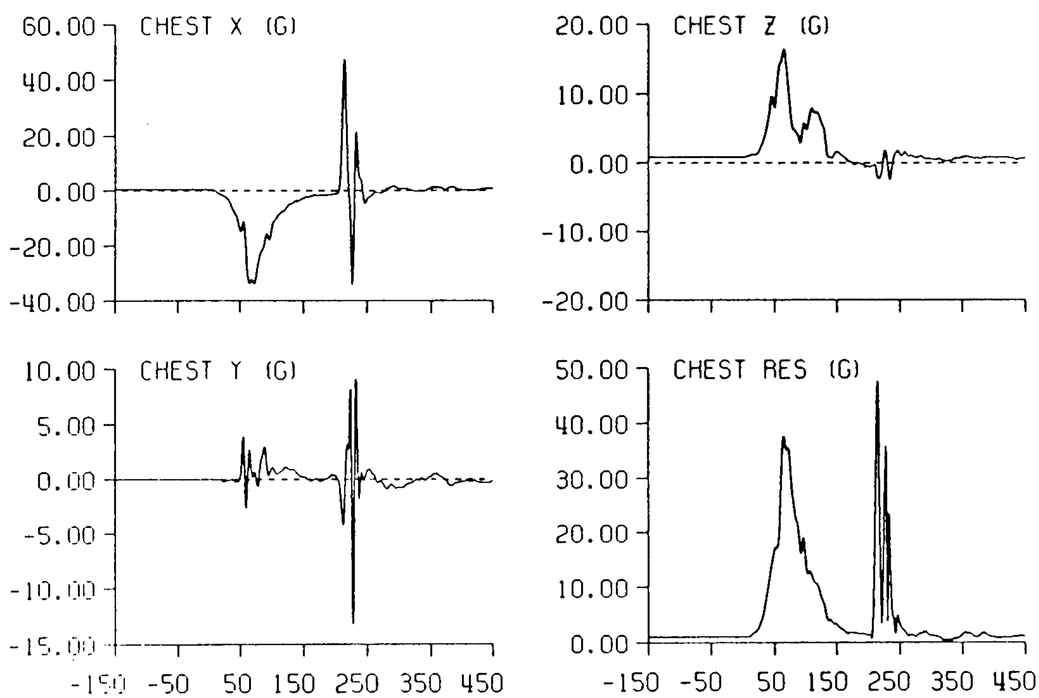


JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L



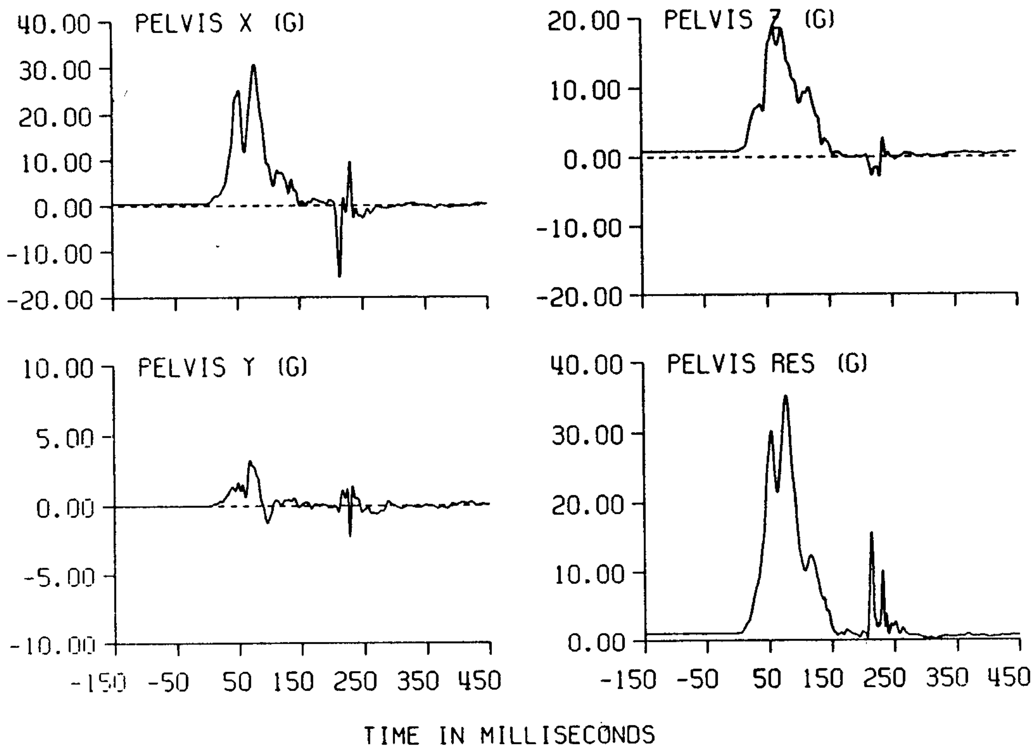
TIME IN MILLISECONDS

JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L

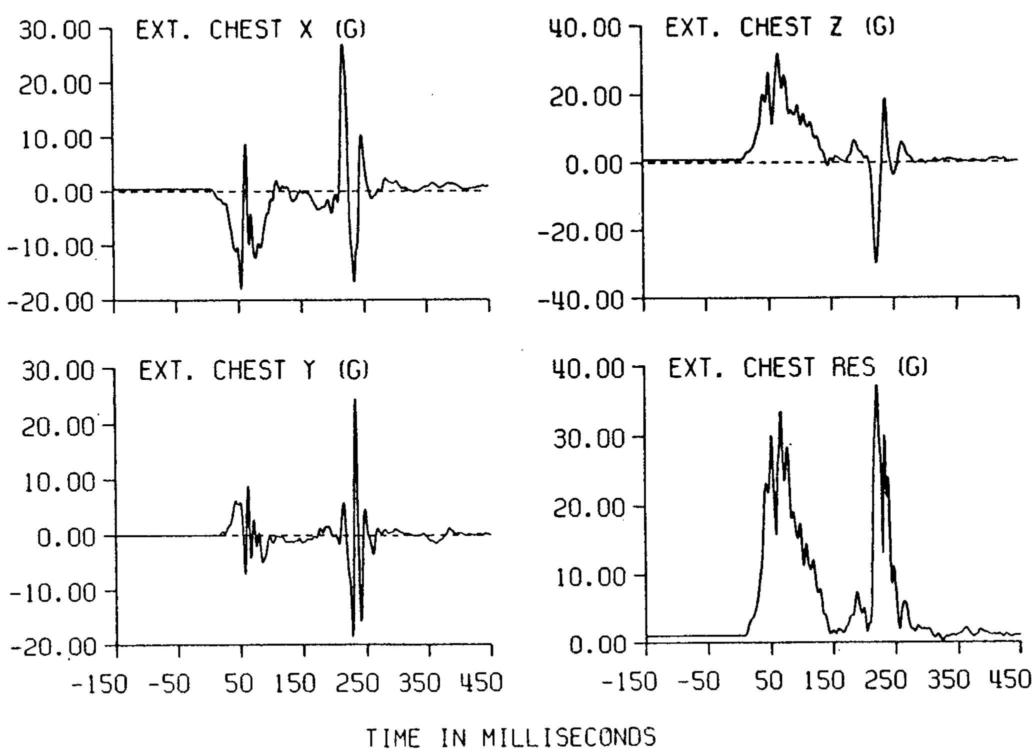


TIME IN MILLISECONDS

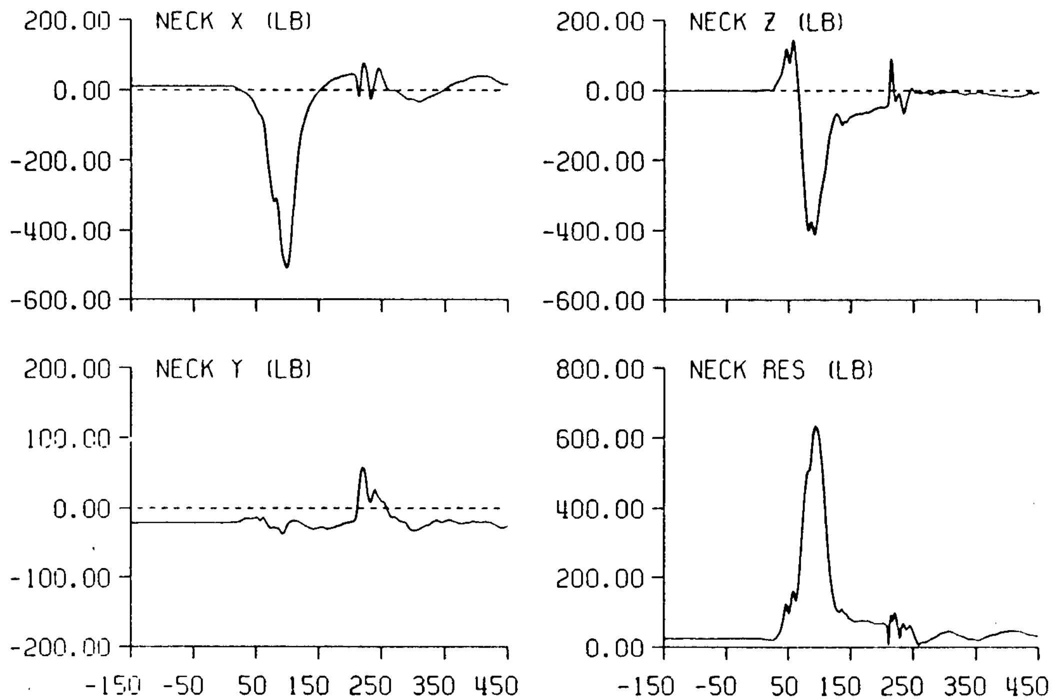
JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L



JPATS -GX STUDY TEST: 5336 SUBJ: ADAM-L CELL: L

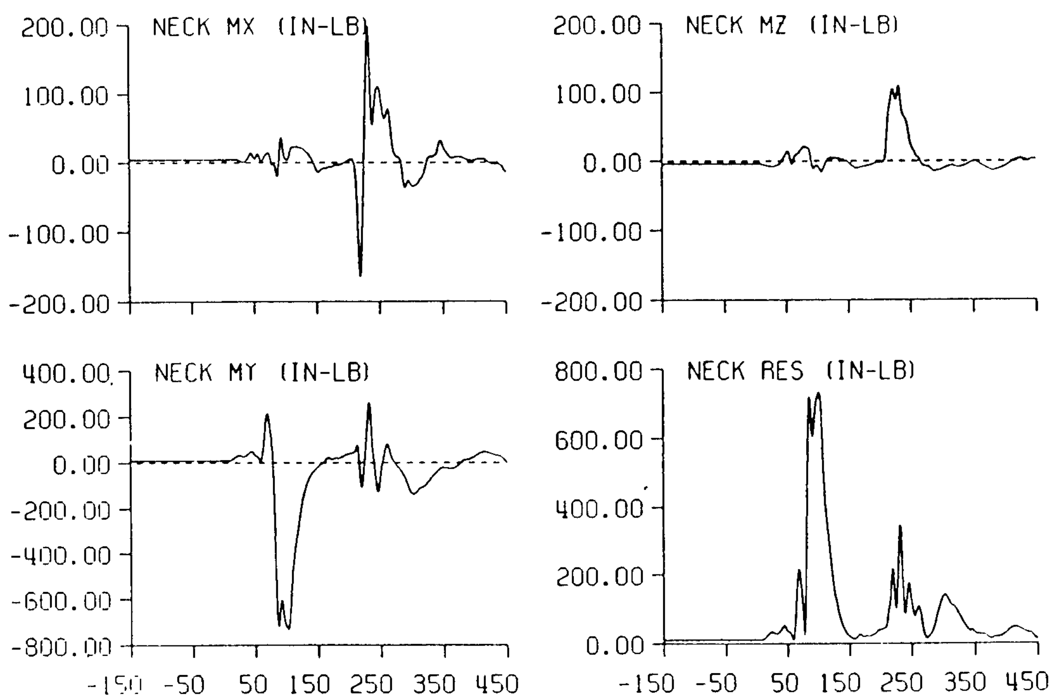


JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L

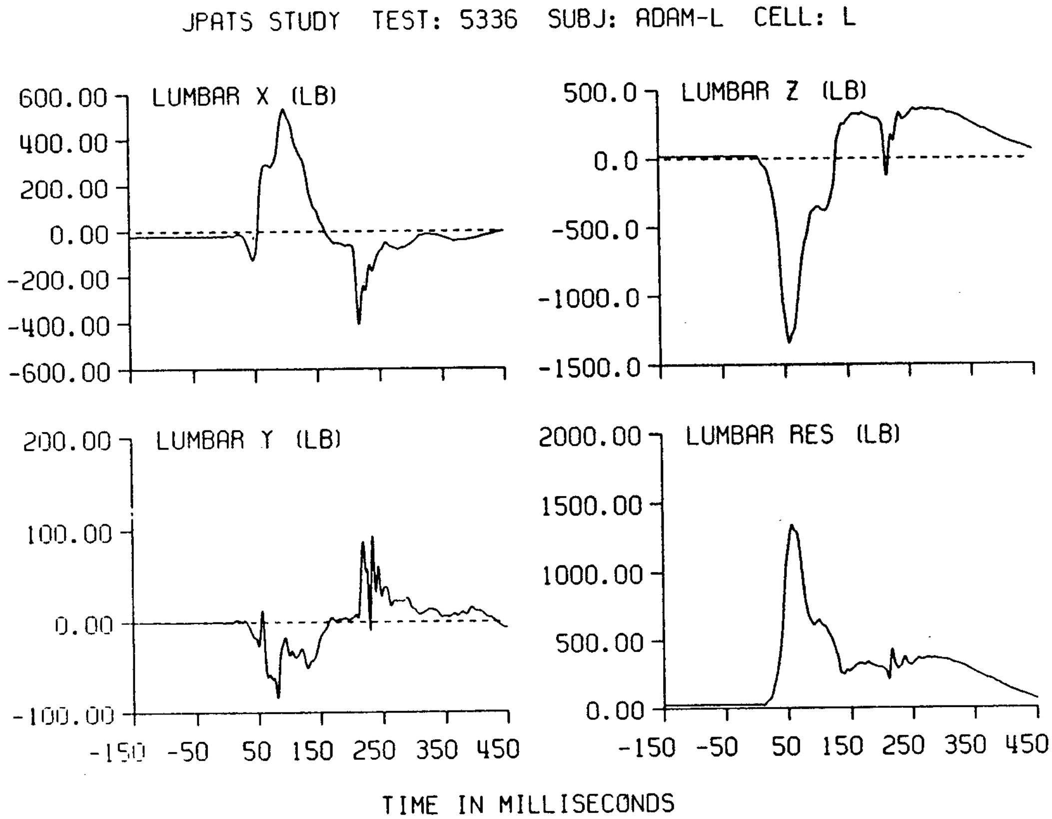


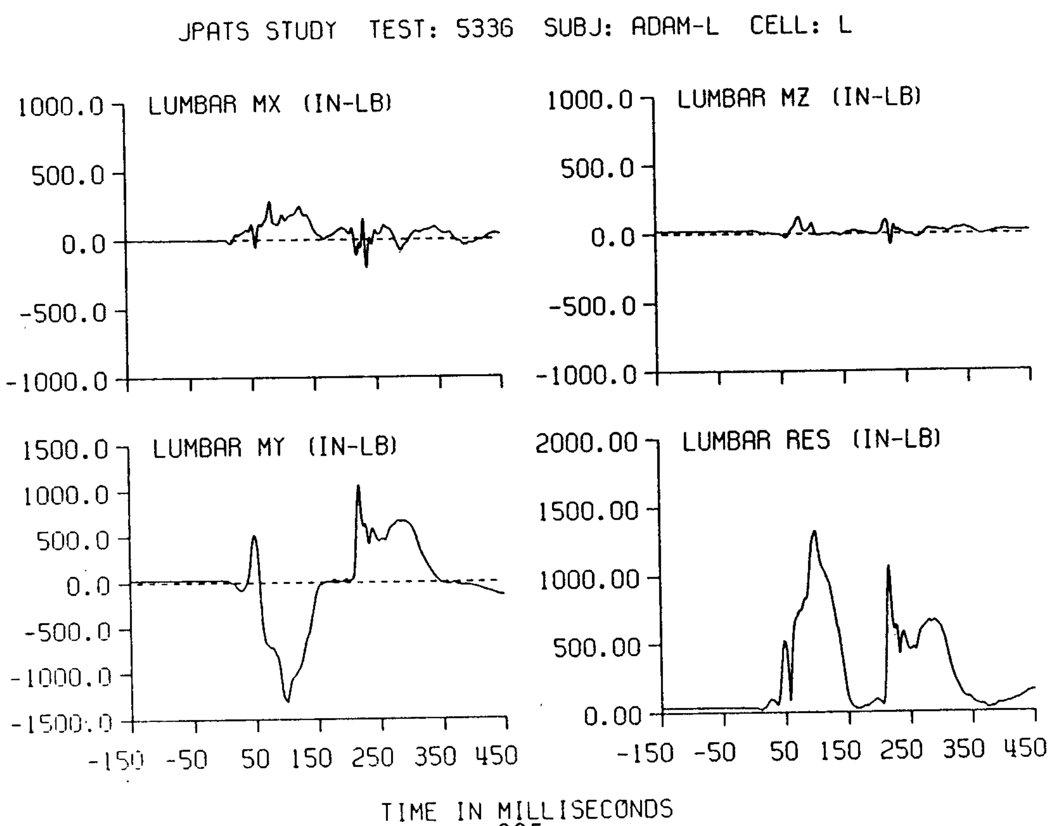
TIME IN MILLISECONDS

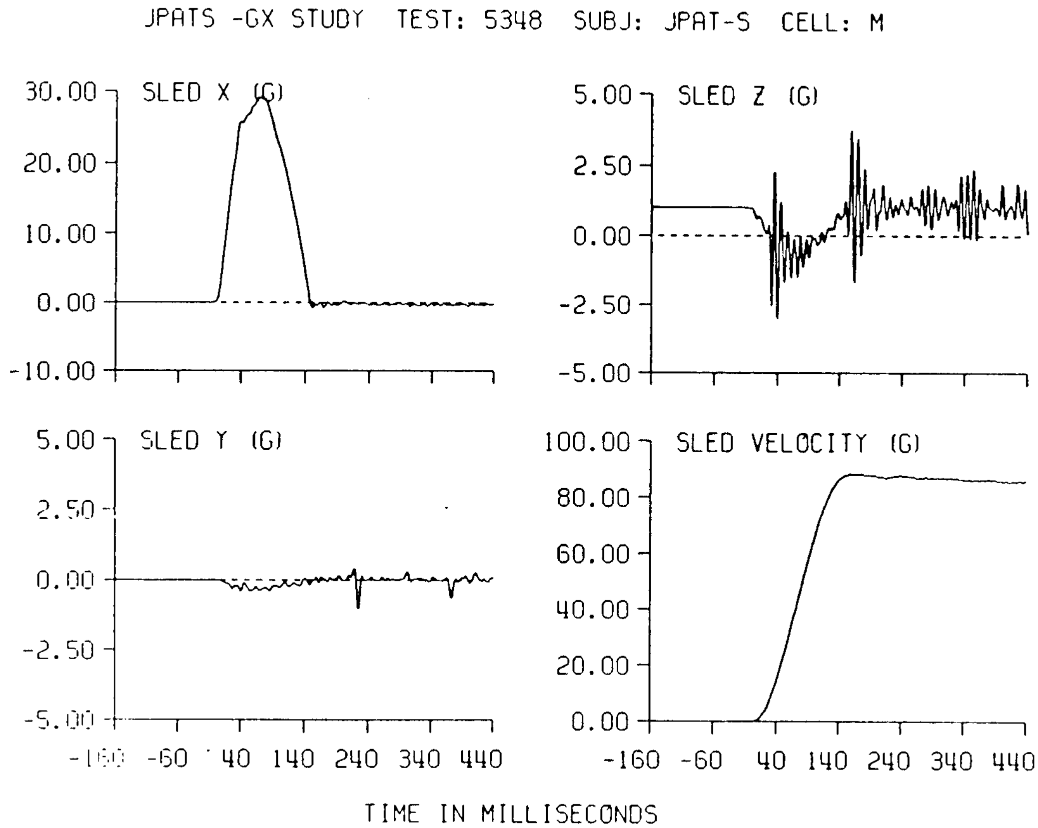
JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L

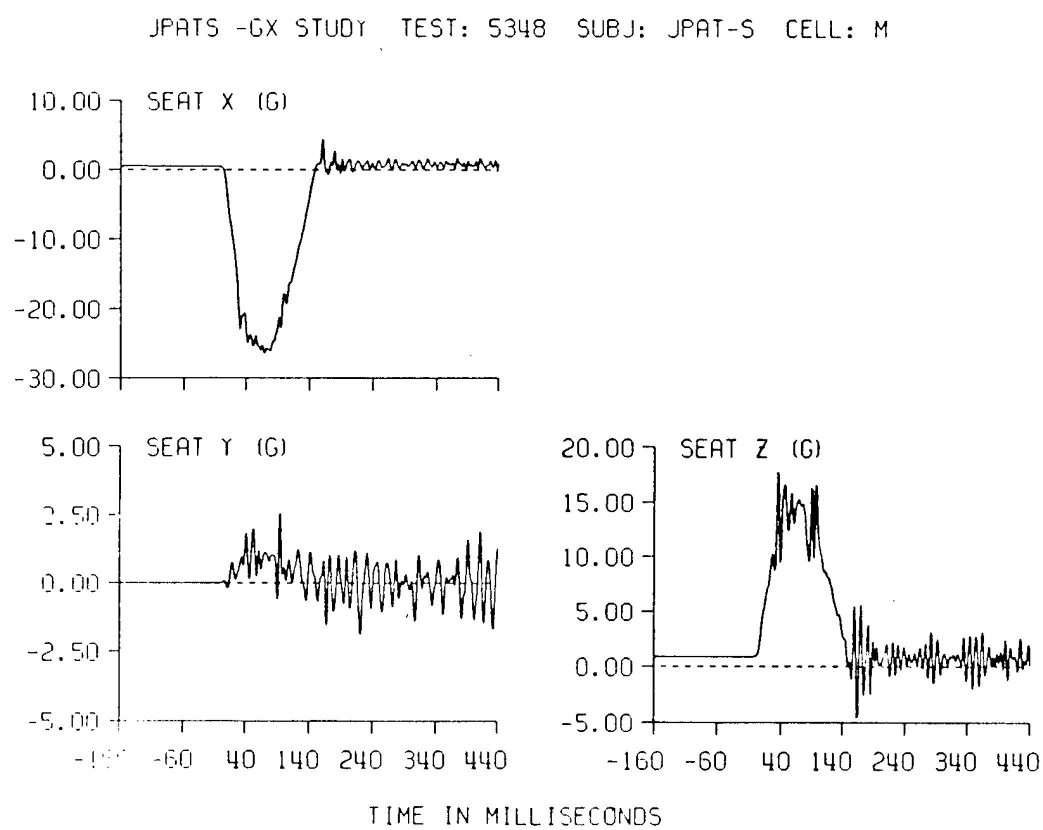


TIME IN MILLISECONDS

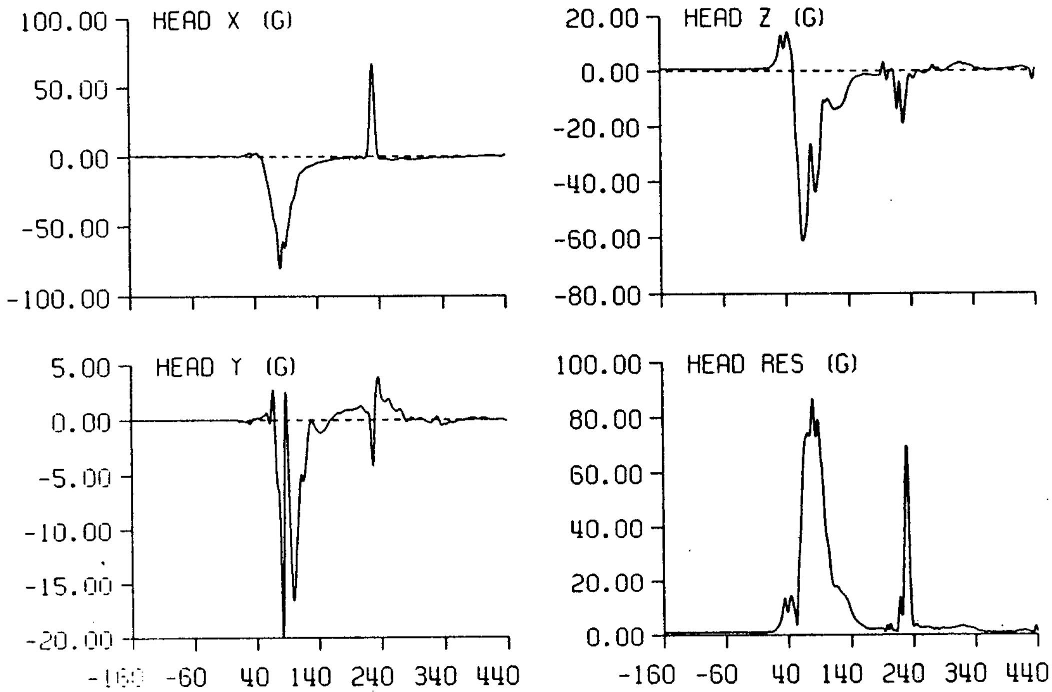

JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L
LUMBAR X (LB)
600.00
400.00
200.00
0.00
-200.00
-400.00
-600.00
LUMBAR Z (LB)
500.0
0.0
-500.0
-1000.0
-1500.0
LUMBAR Y (LB)
200.00
100.00
0.00
-100.00
LUMBAR RES (LB)
2000.00
1500.00
1000.00
500.00
0.00
-150 -50 50 150 250 350 450
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS


JPATS STUDY TEST: 5336 SUBJ: ADAM-L CELL: L
LUMBAR MX (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
LUMBAR MZ (IN-LB)
1000.0
500.0
0.0
-500.0
-1000.0
LUMBAR MY (IN-LB)
1500.0
1000.0
500.0
0.0
-500.0
-1000.0
-1500.0
LUMBAR RES (IN-LB)
2000.00
1500.00
1000.00
500.00
0.00
-150 -50 50 150 250 350 450
-150 -50 50 150 250 350 450
TIME IN MILLISECONDS


JPATS -GX STUDY TEST: 5348 SUBJ: JPAT-S CELL: M
SLED X (G)
SLED Z (G)
SLED Y (G)
SLED VELOCITY (G)
TIME IN MILLISECONDS

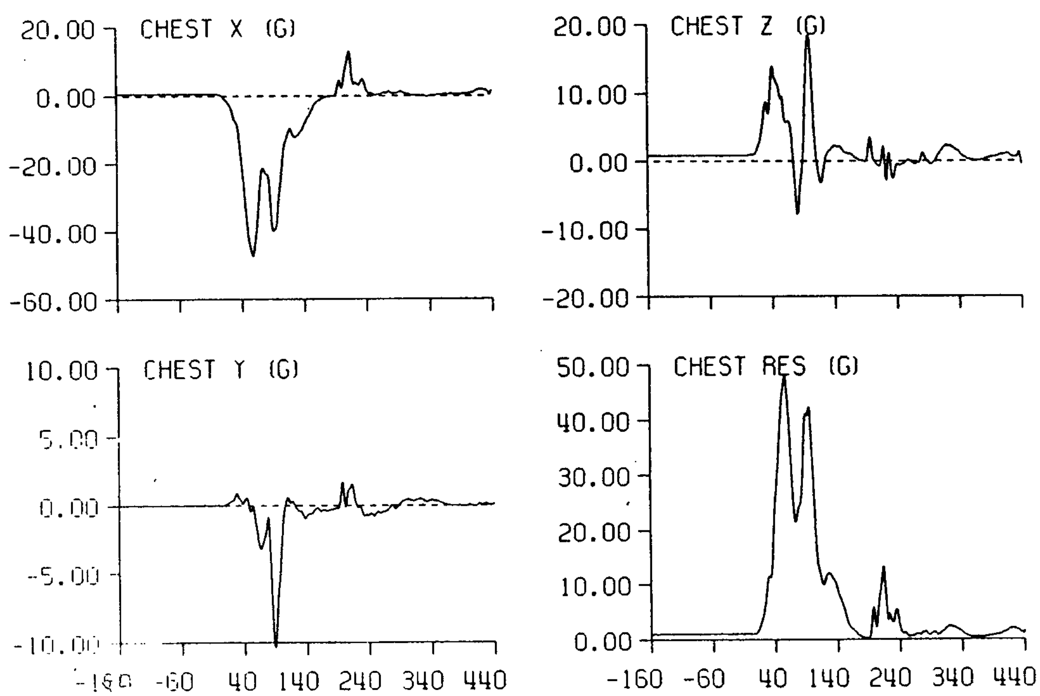

JPATS -GX STUDY TEST: 5348 SUBJ: JPAT-S CELL: M
SEAT X (G)
SEAT Y (G)
SEAT Z (G)
TIME IN MILLISECONDS

JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



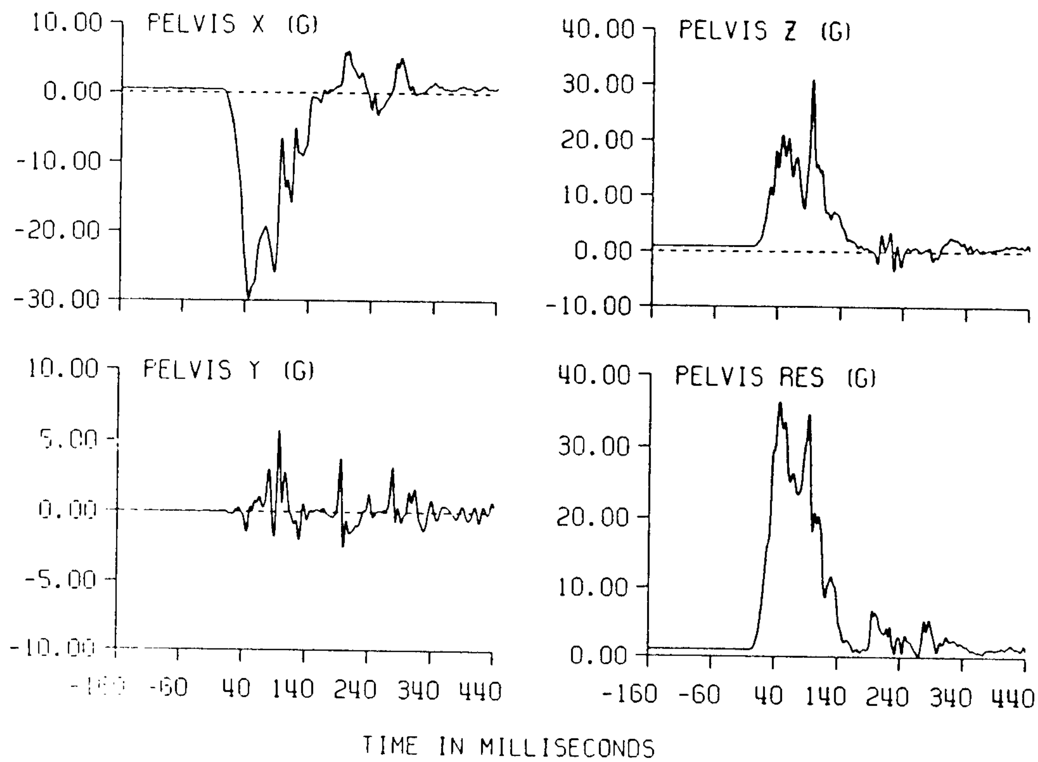
TIME IN MILLISECONDS

JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M

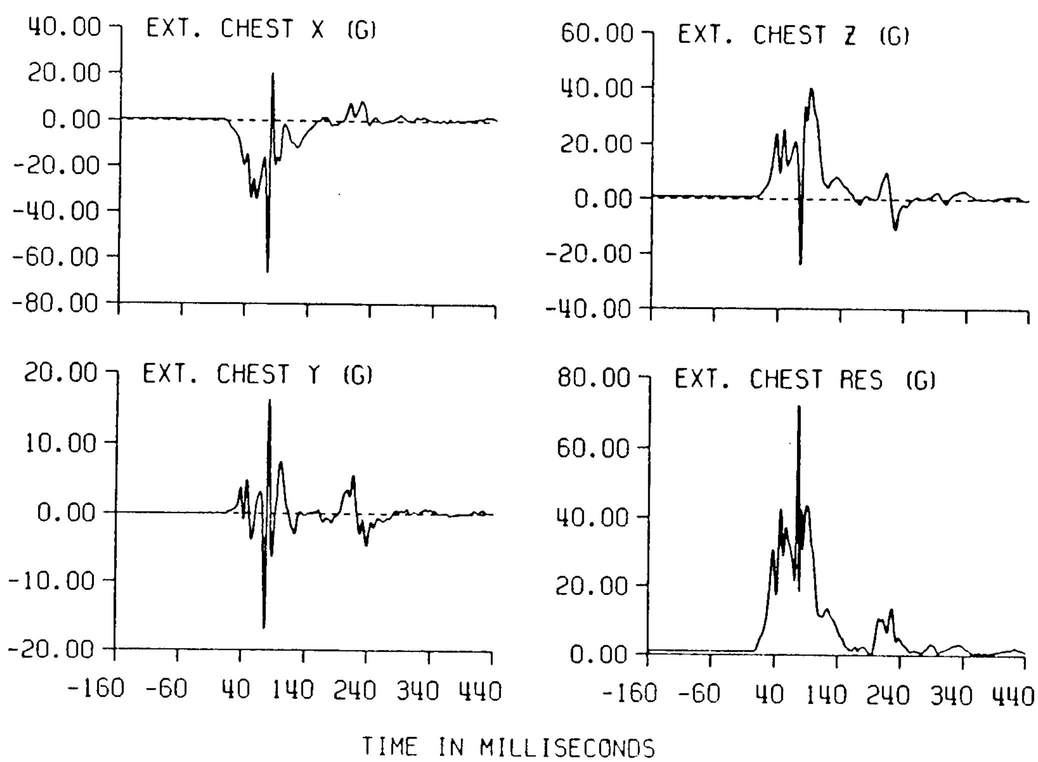


TIME IN MILLISECONDS

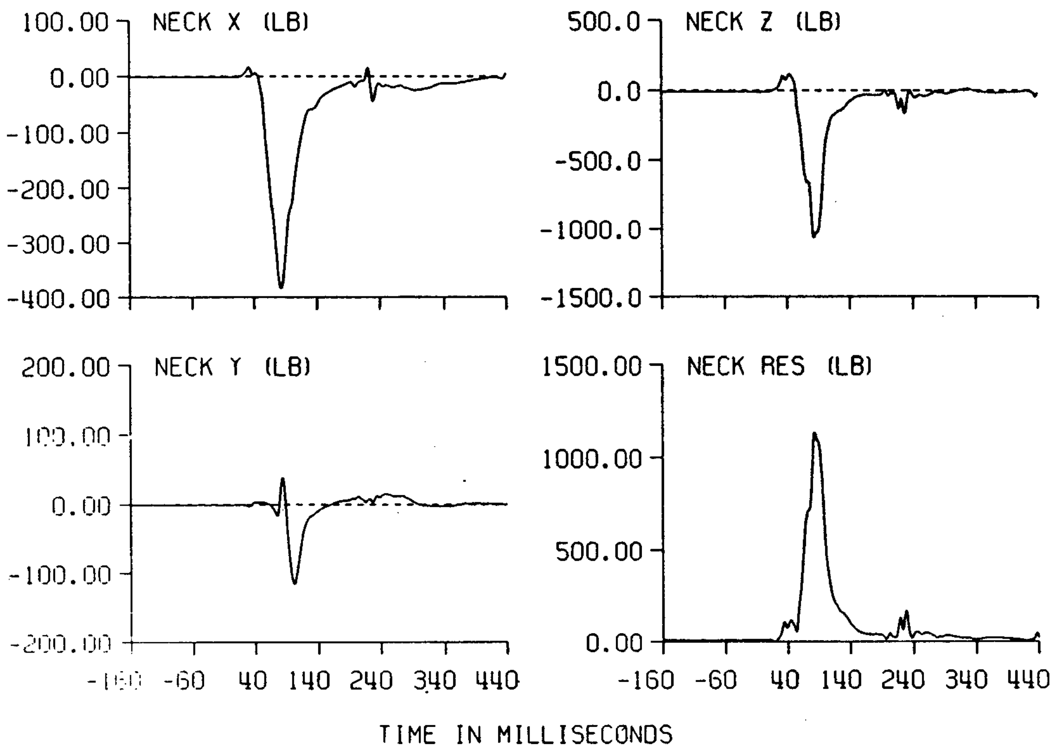
JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



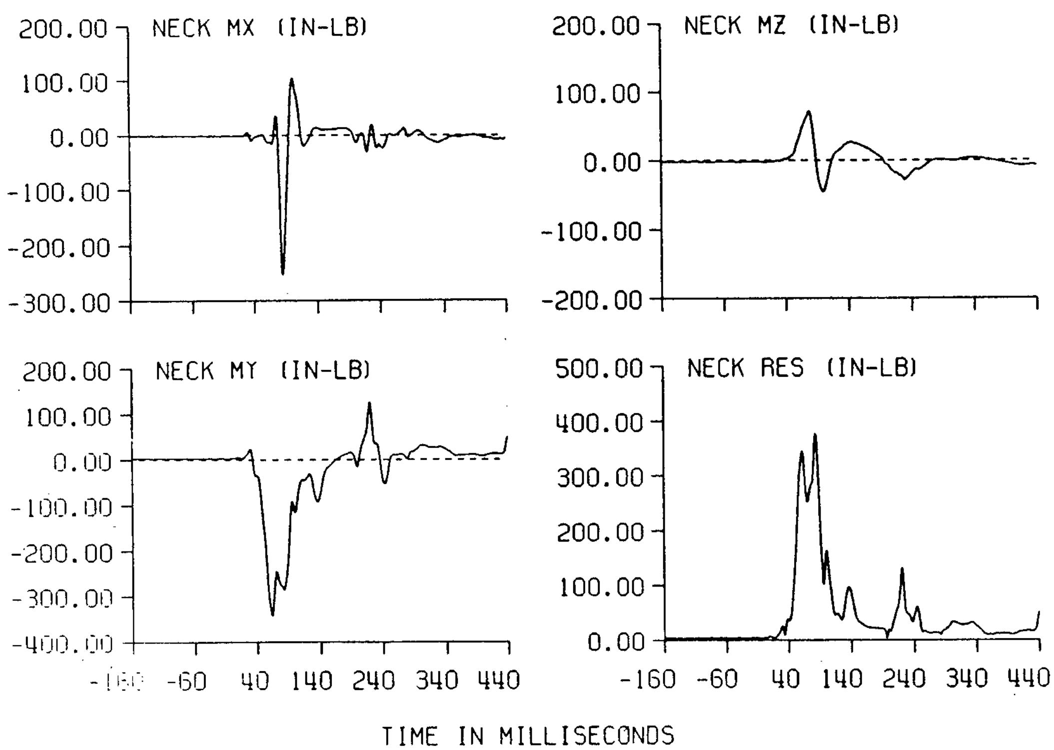
JPATS -GX STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



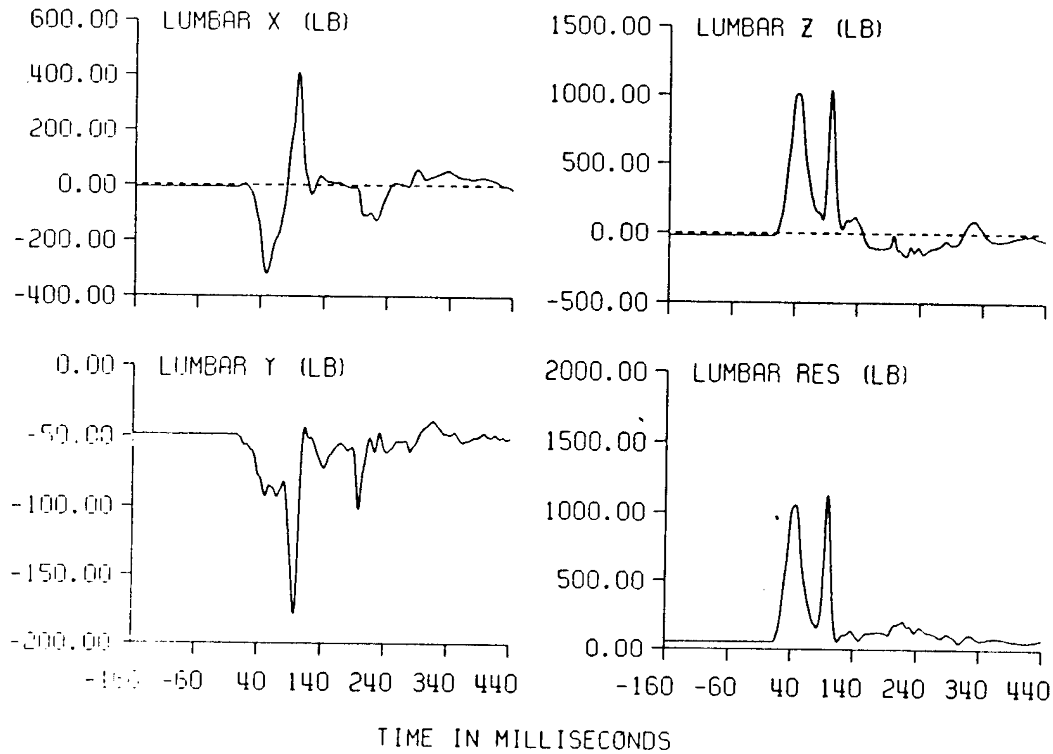
JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



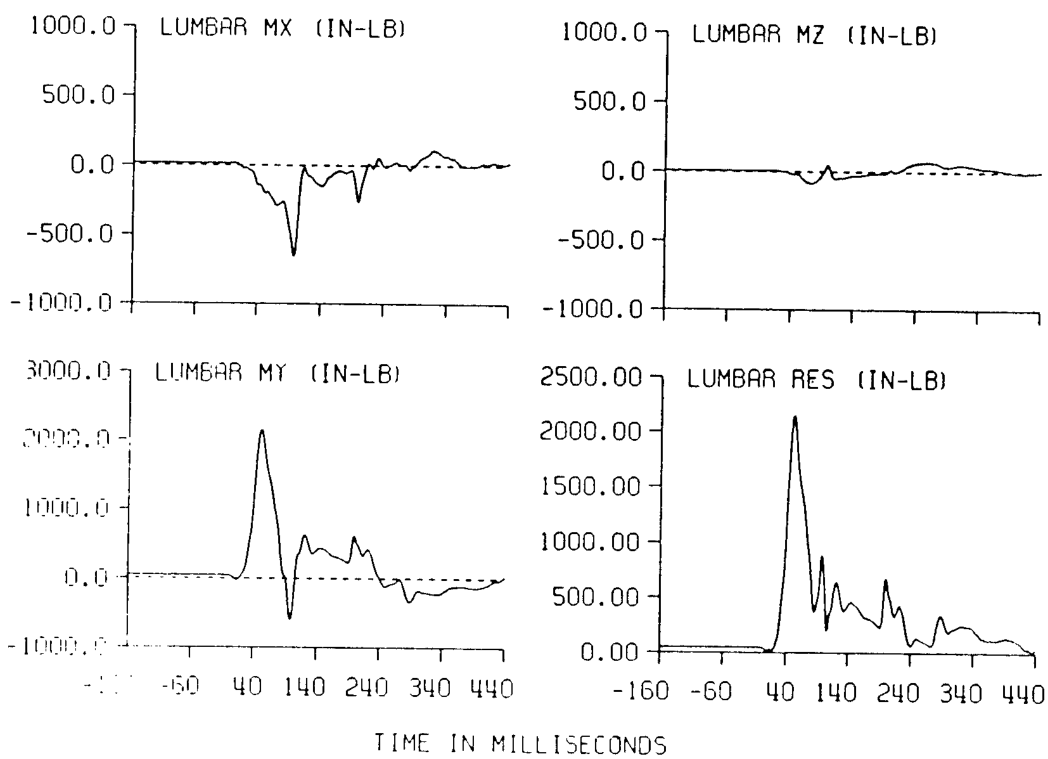
JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



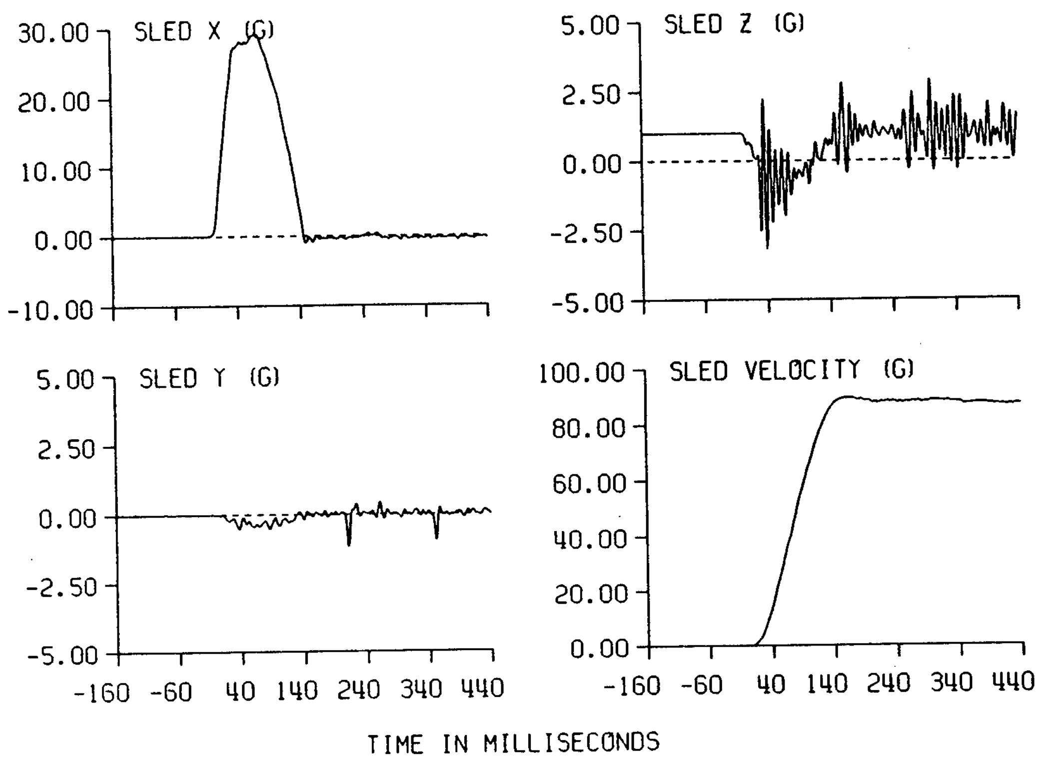
JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



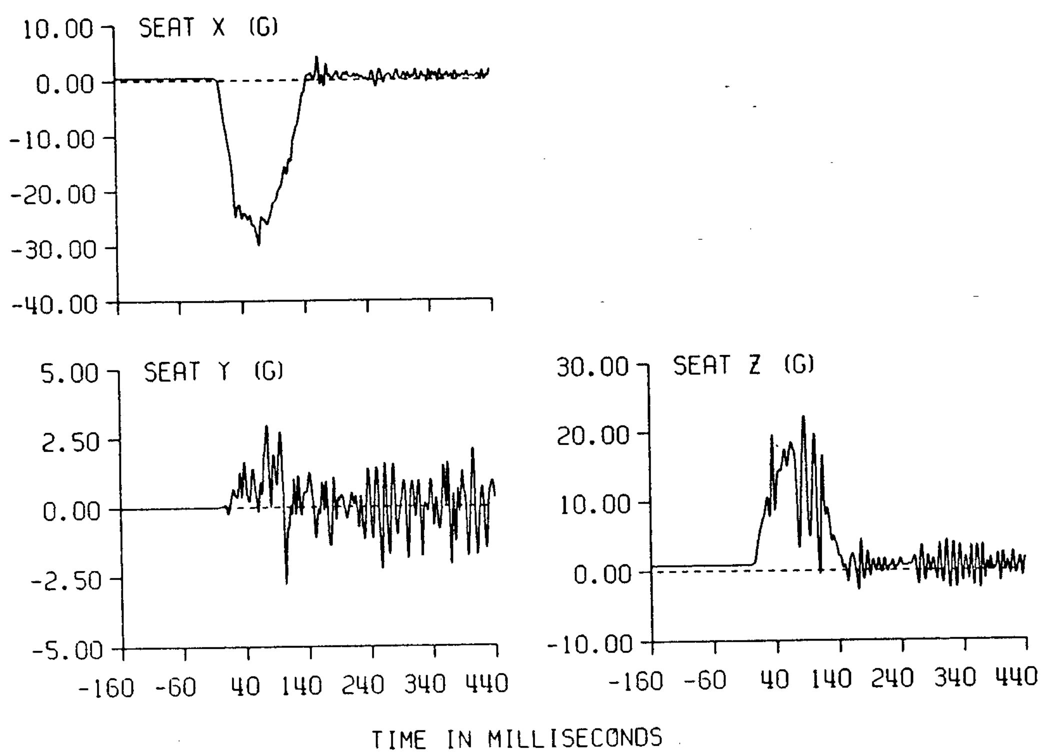
JPATS STUDY TEST: 5348 SUBJ: JPAT-S CELL: M



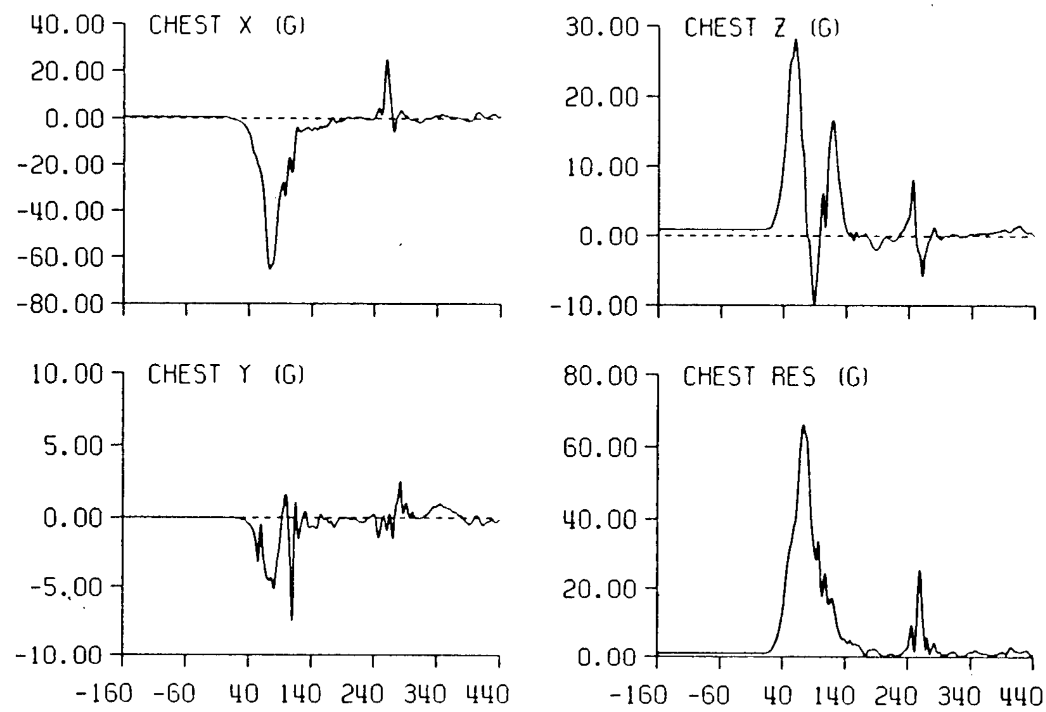
JPATS -GX STUDY TEST: 5351 SUBJ: JPAT-L CELL: M



JPATS -GX STUDY TEST: 5351 SUBJ: JPAT-L CELL: M

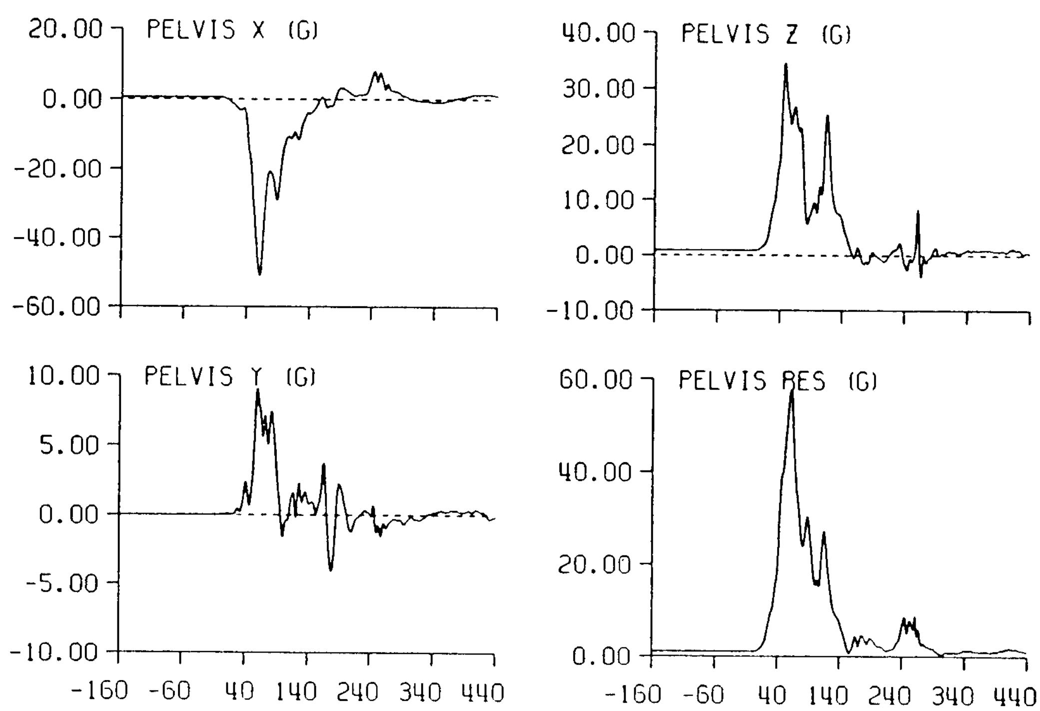


JPATS STUDY TEST: 5351 SUBJ: JPAT-L CELL: M



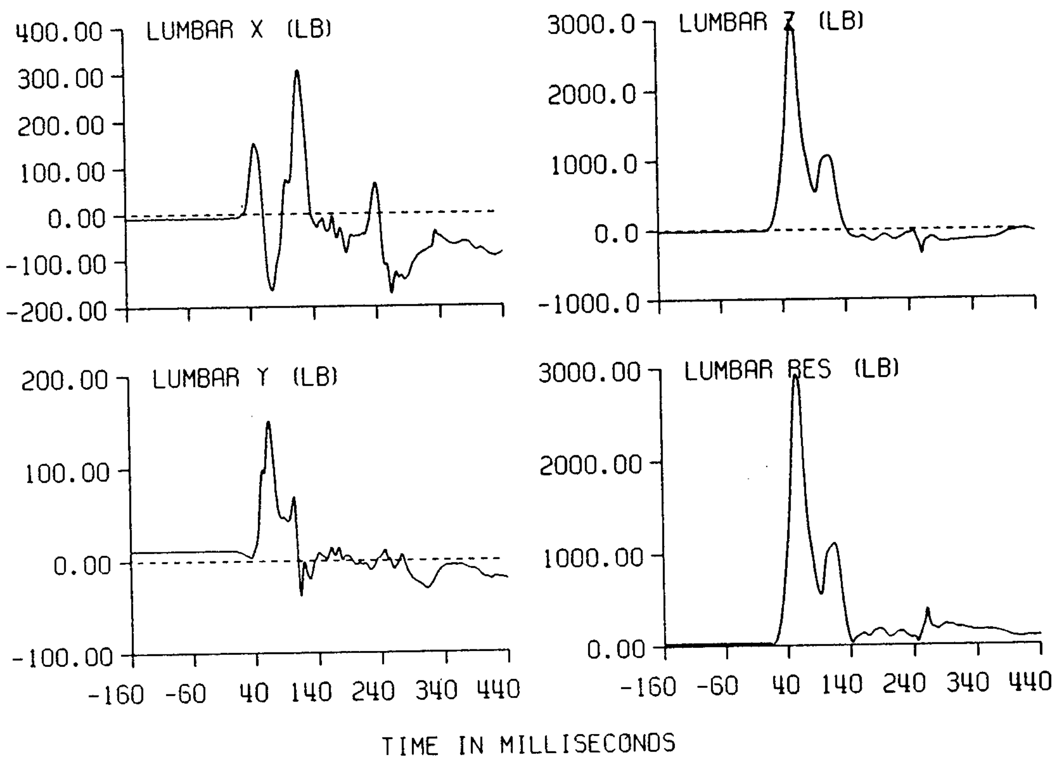
TIME IN MILLISECONDS

JPATS STUDY TEST: 5351 SUBJ: JPAT-L CELL: M

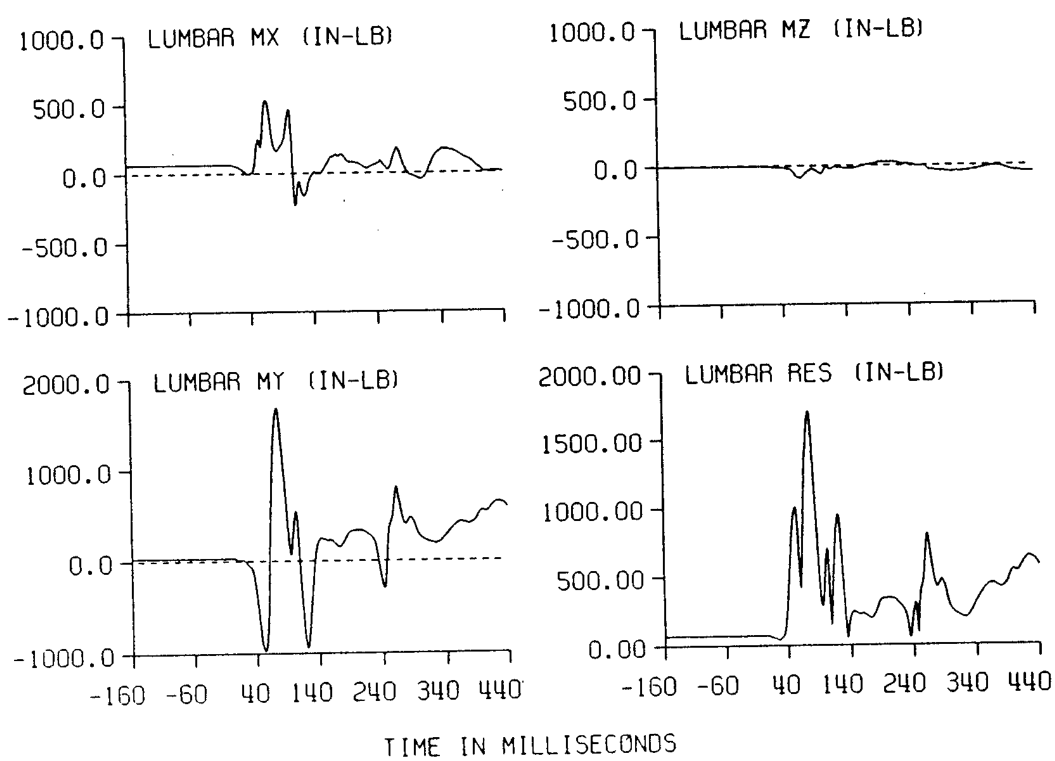


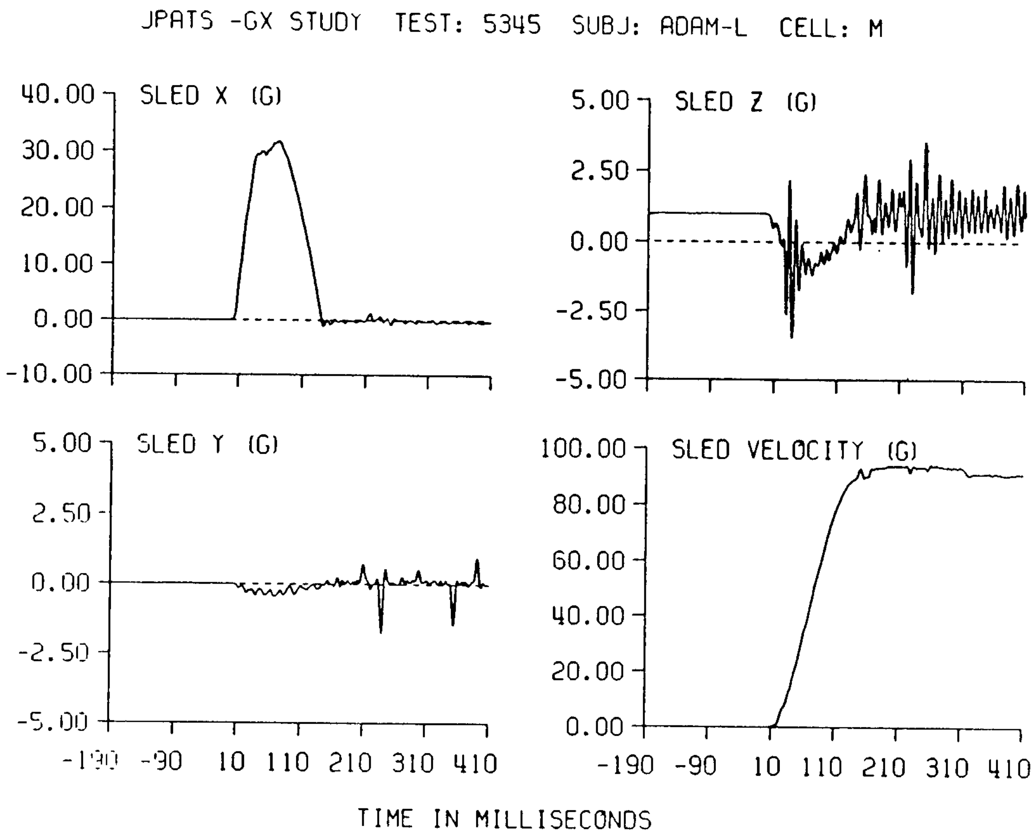
TIME IN MILLISECONDS

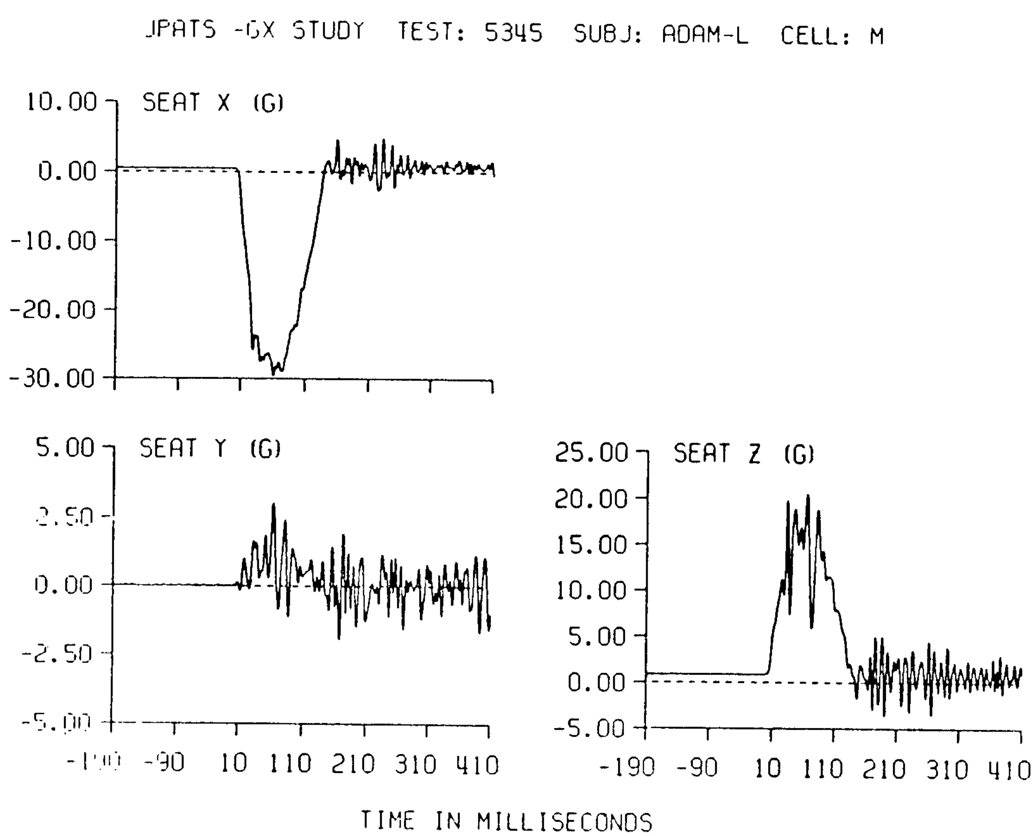
JPATS STUDY TEST: 5351 SUBJ: JPAT-L CELL: M



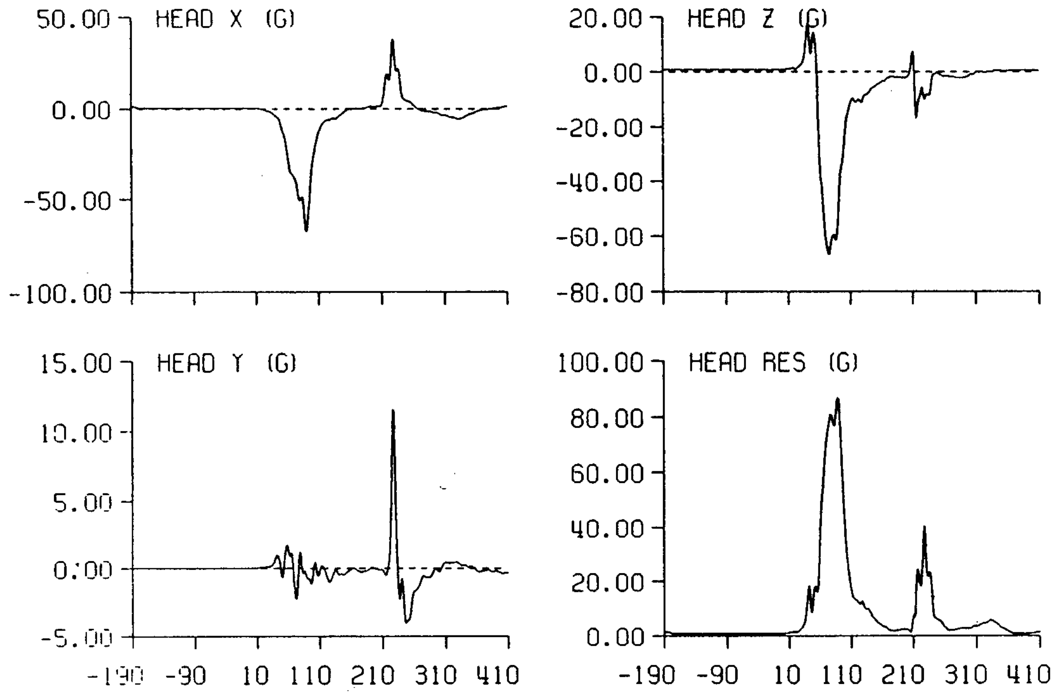
JPATS STUDY TEST: 5351 SUBJ: JPAT-L CELL: M




JPATS -GX STUDY TEST: 5345 SUBJ: ADAM-L CELL: M
SLED X (G)
SLED Z (G)
SLED Y (G)
SLED VELOCITY (G)
TIME IN MILLISECONDS

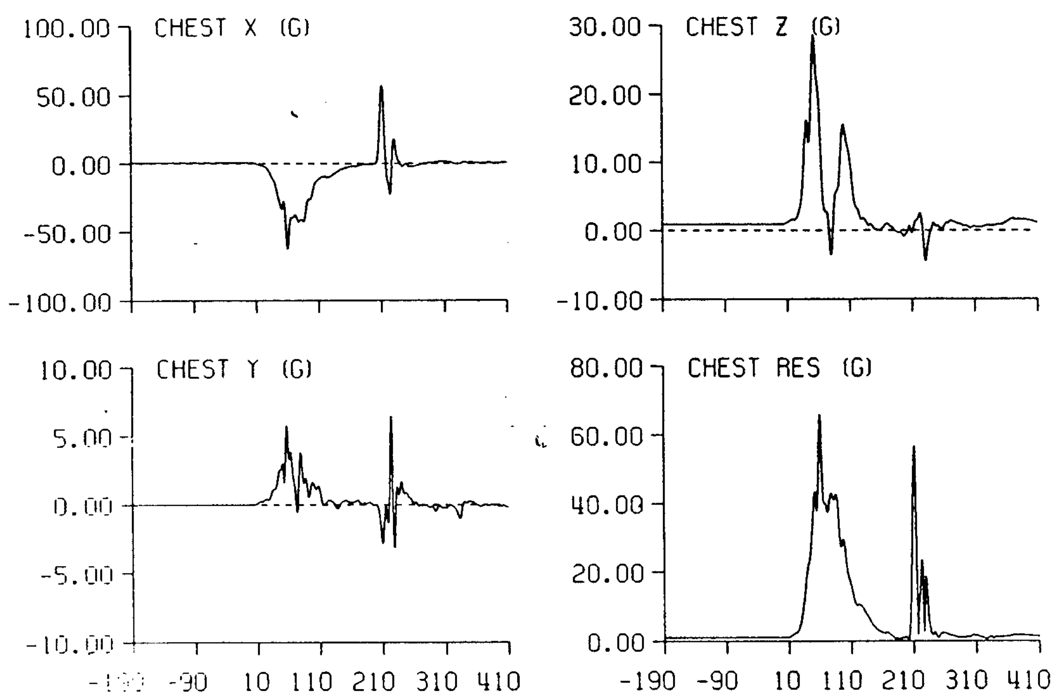

JPATS -GX STUDY TEST: 5345 SUBJ: ADAM-L CELL: M
SEAT X (G)
SEAT Y (G)
SEAT Z (G)
TIME IN MILLISECONDS

JPATS STUDY   TEST: 5345   SUBJ: ADAM-L   CELL: M



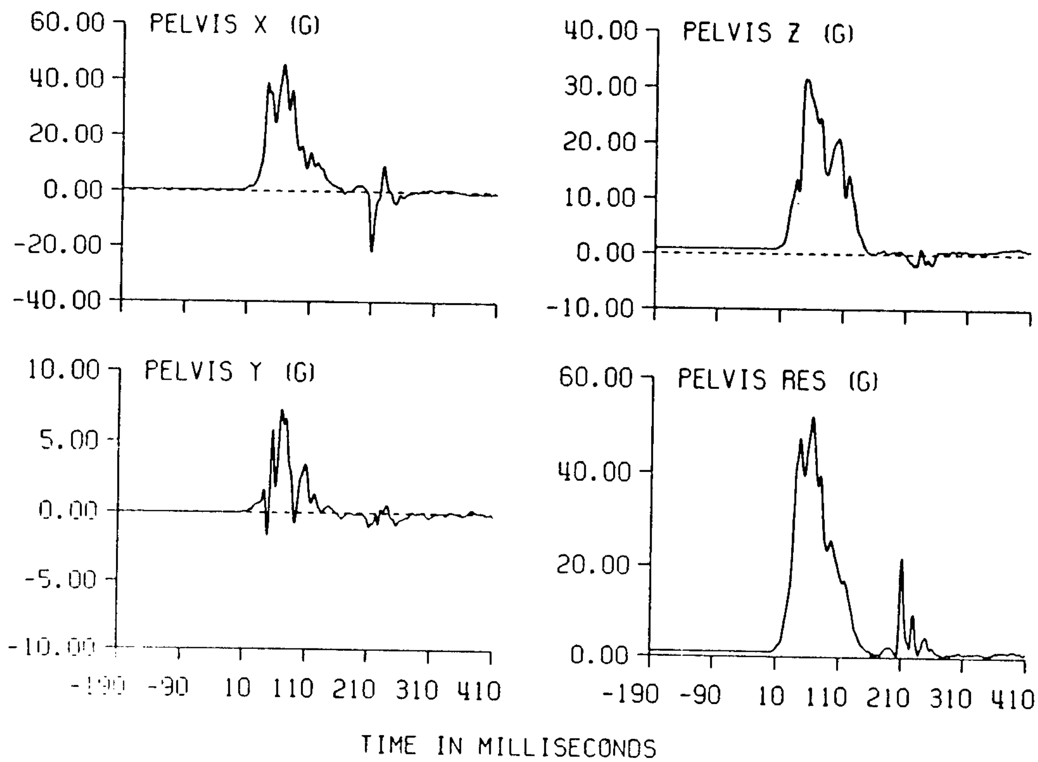
TIME IN MILLISECONDS

JPATS STUDY   TEST: 5345   SUBJ: ADAM-L   CELL: M

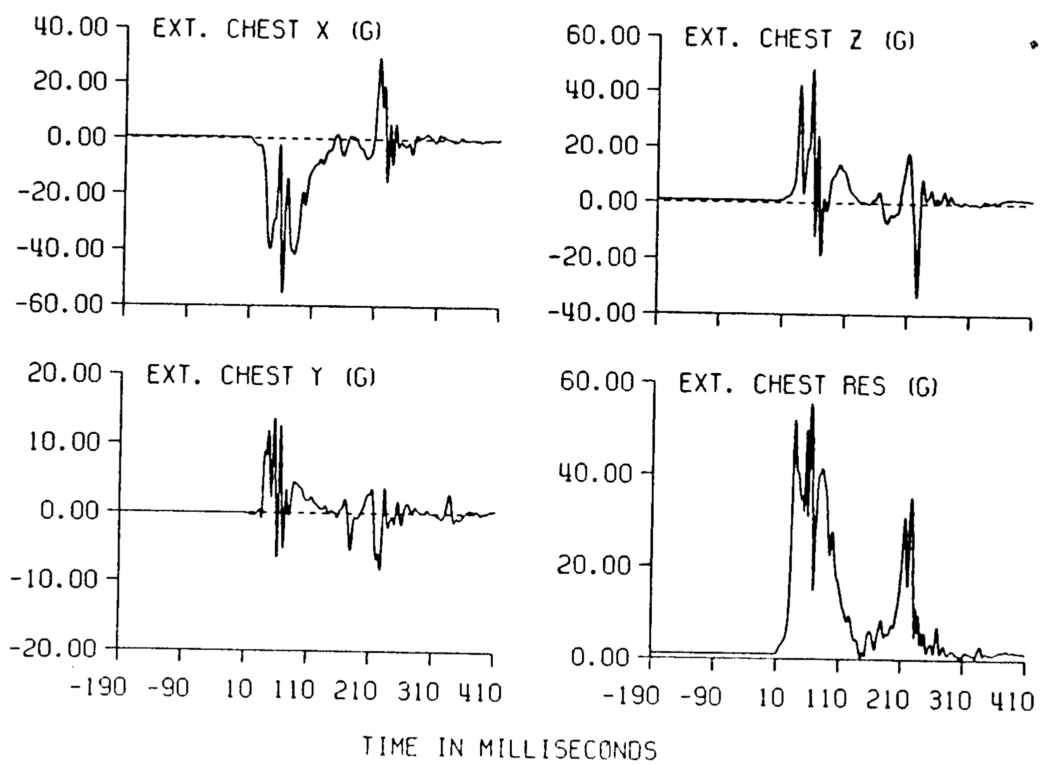


TIME IN MILLISECONDS

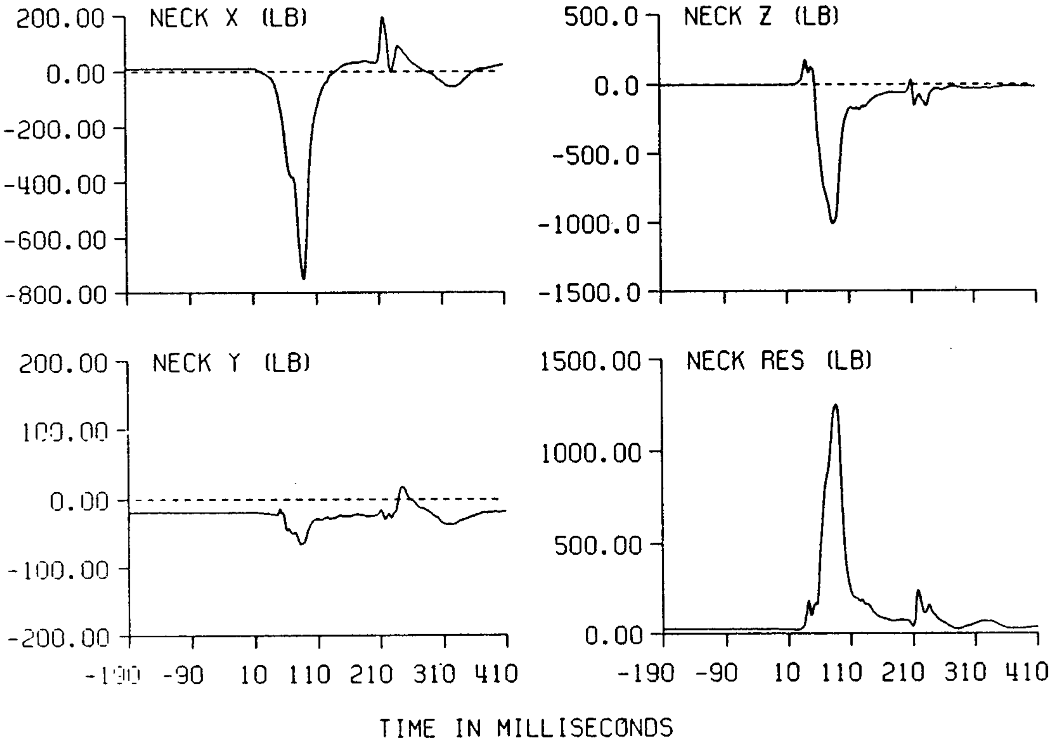
JPATS STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



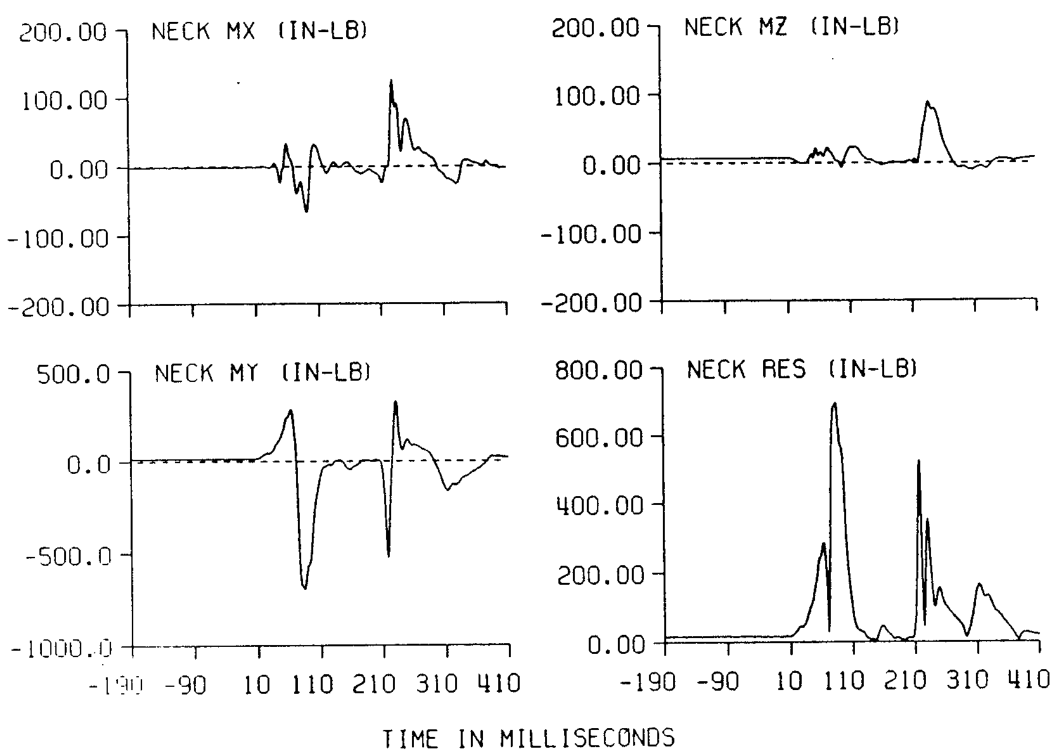
JPATS -GX STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



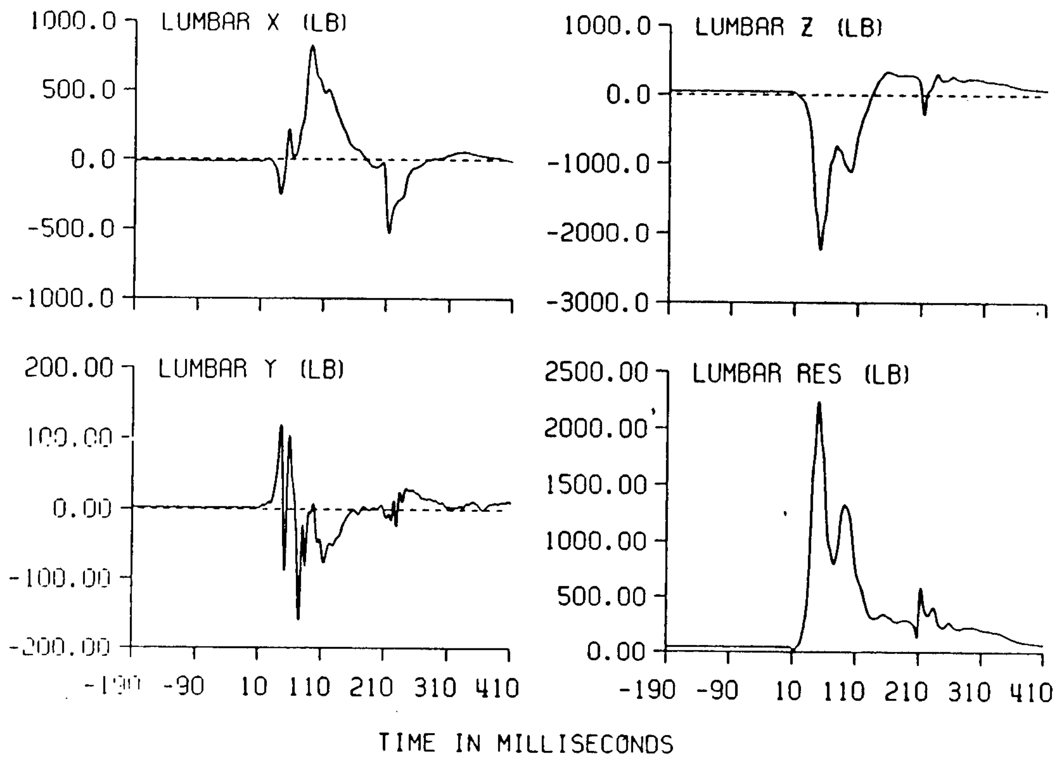
JPATS STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



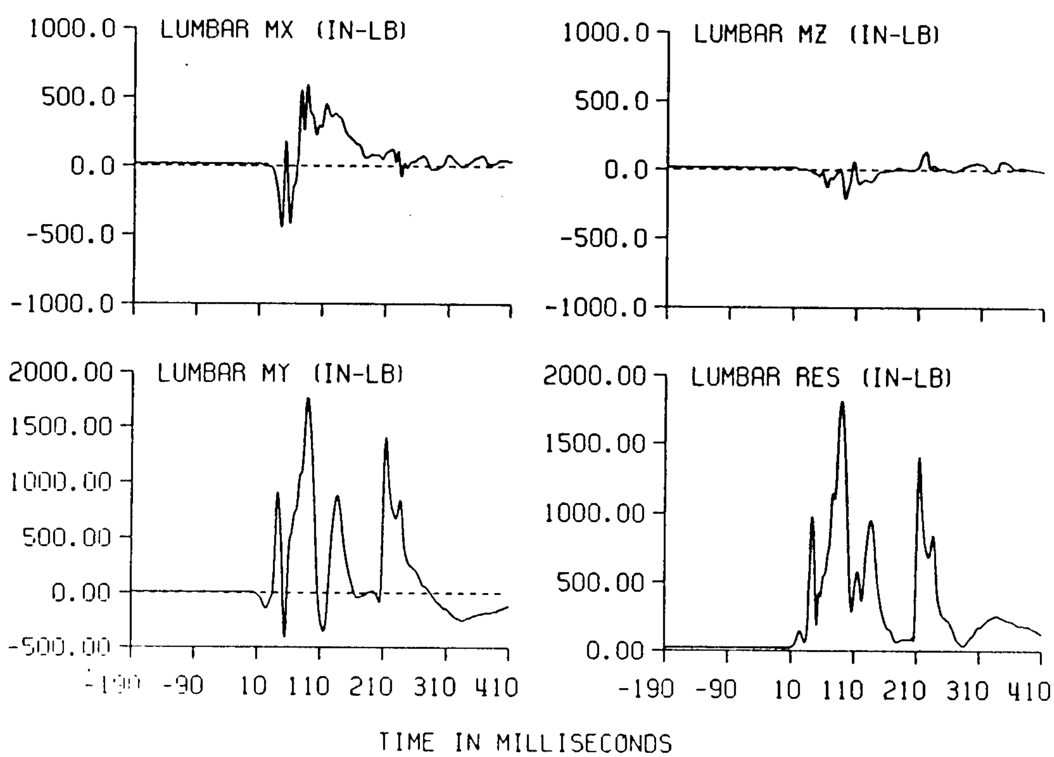
JPATS STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



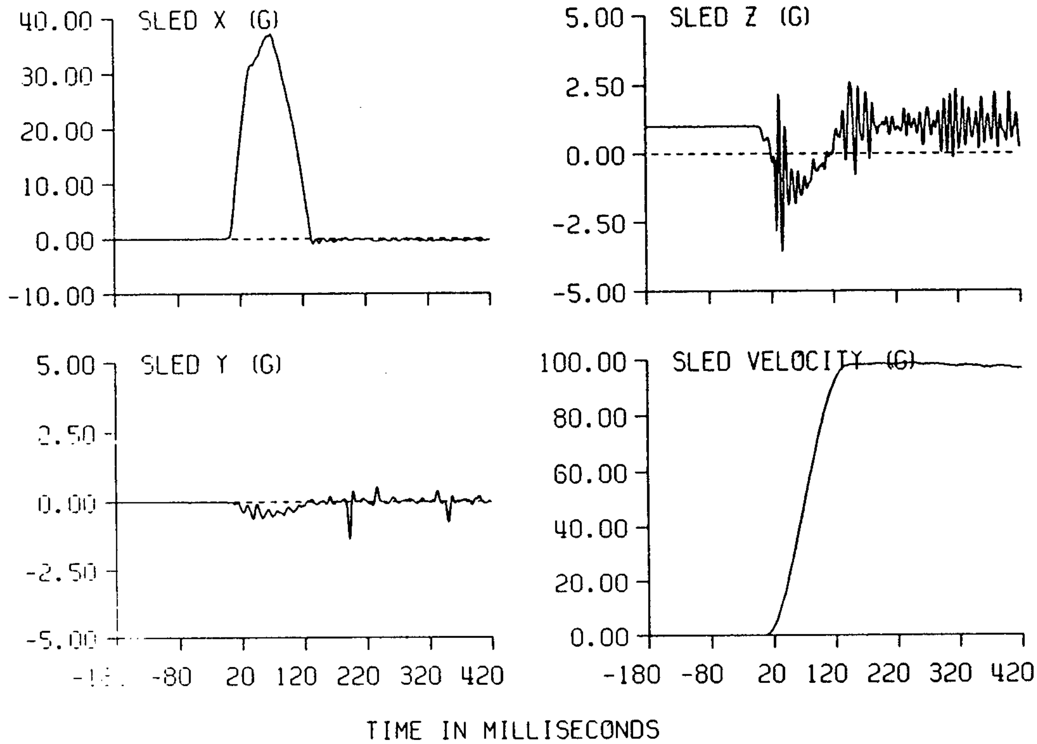
JPATS STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



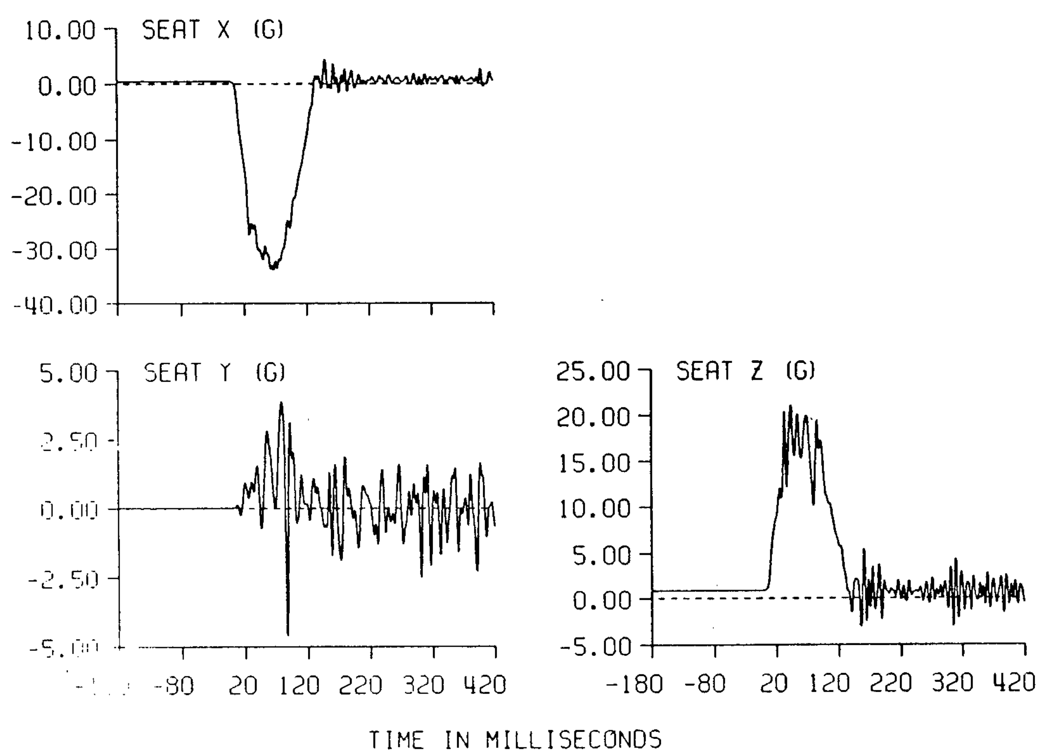
JPATS STUDY TEST: 5345 SUBJ: ADAM-L CELL: M



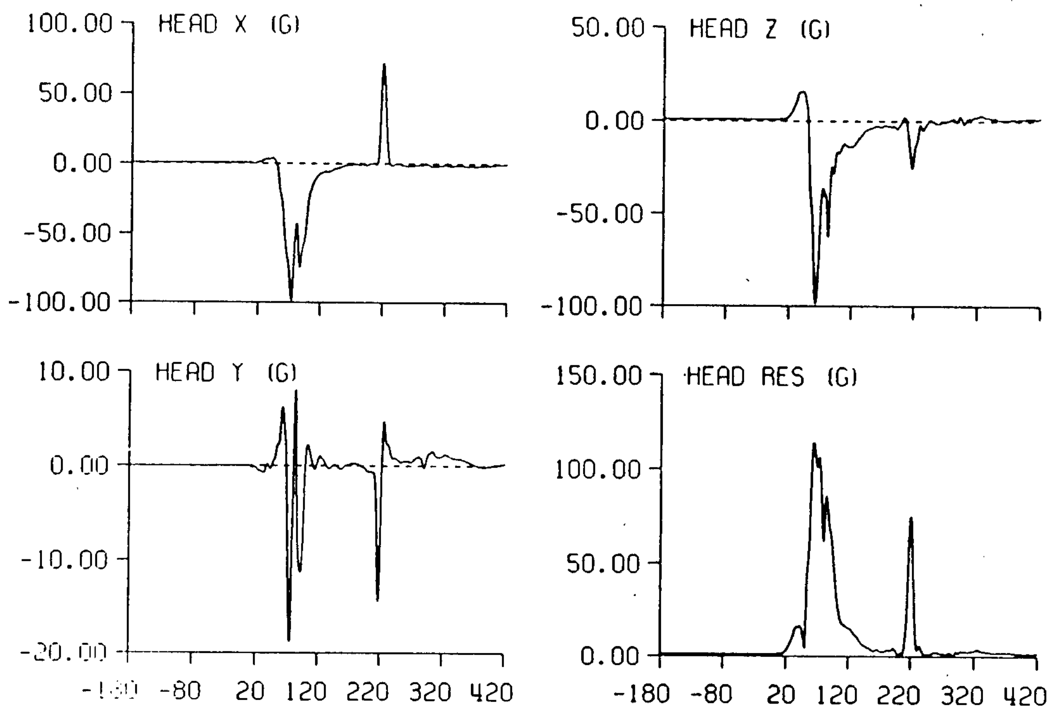
JPATS -GX STUDY TEST: 5350 SUBJ: JPAT-S CELL: N



JPATS -GX STUDY TEST: 5350 SUBJ: JPAT-S CELL: N

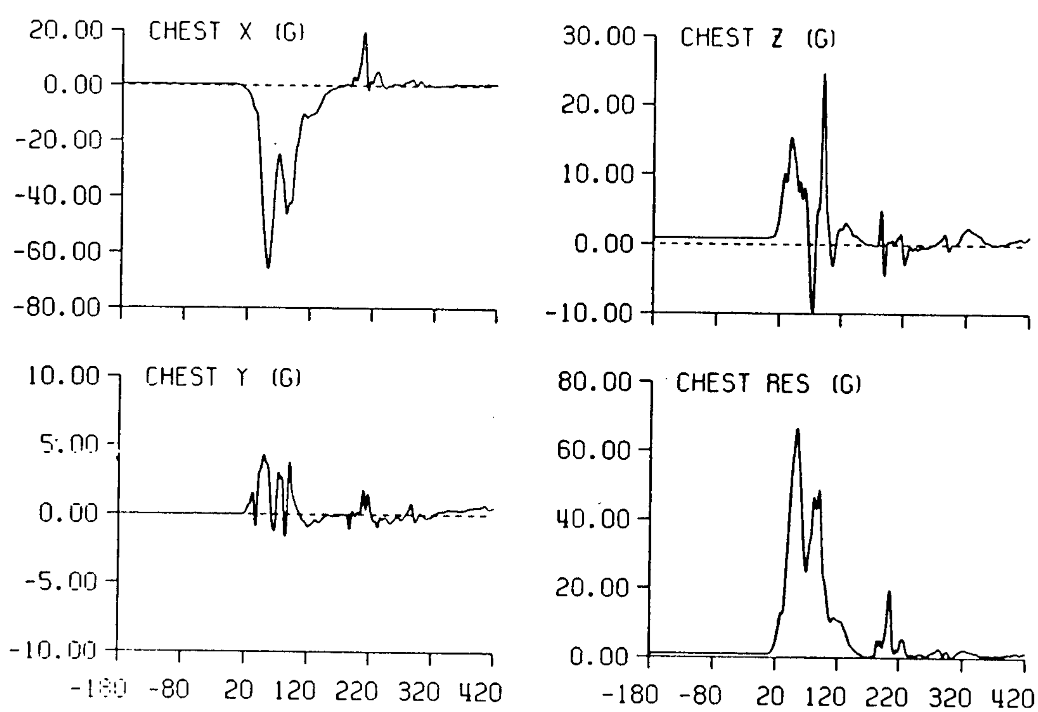


JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N



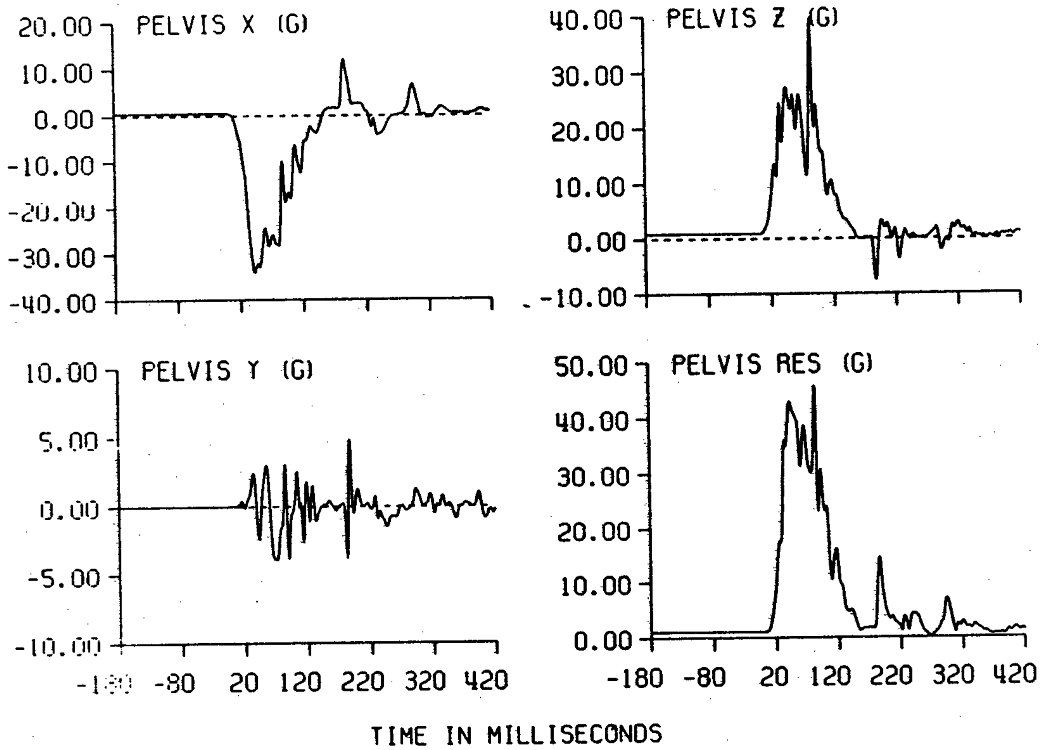
TIME IN MILLISECONDS

JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N

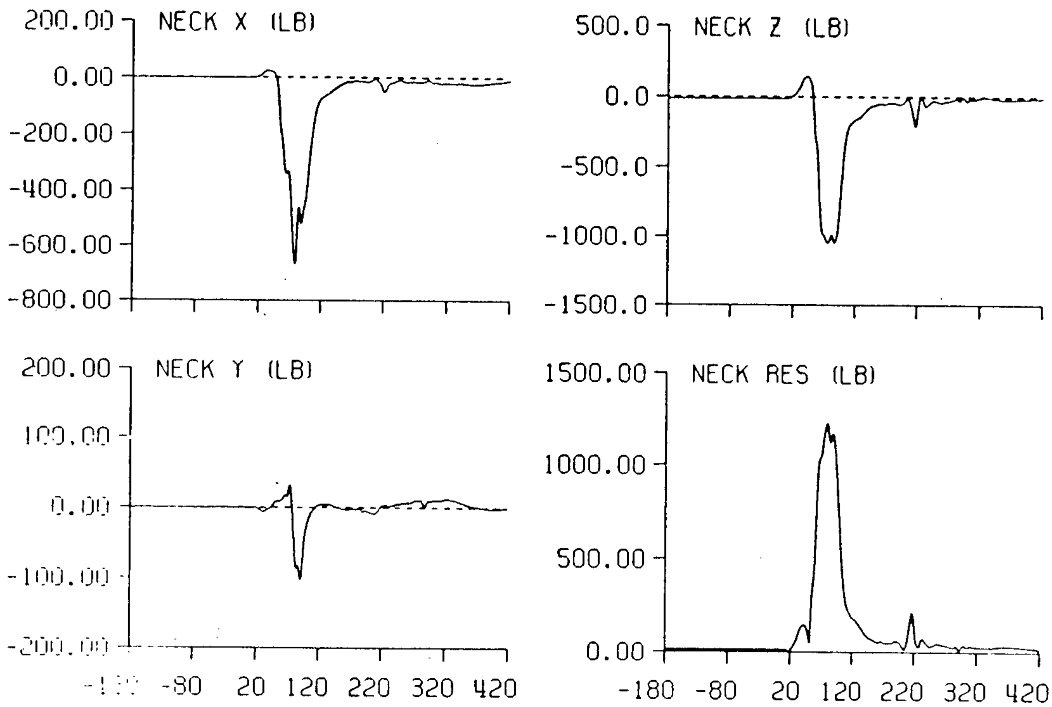


TIME IN MILLISECONDS

JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N

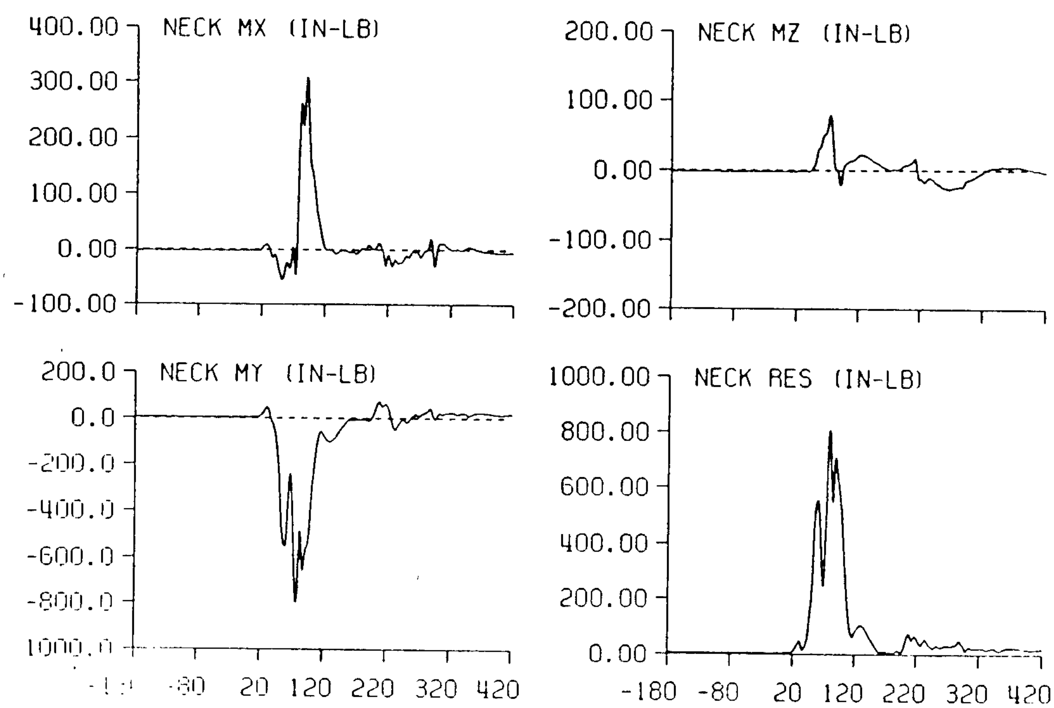


JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N



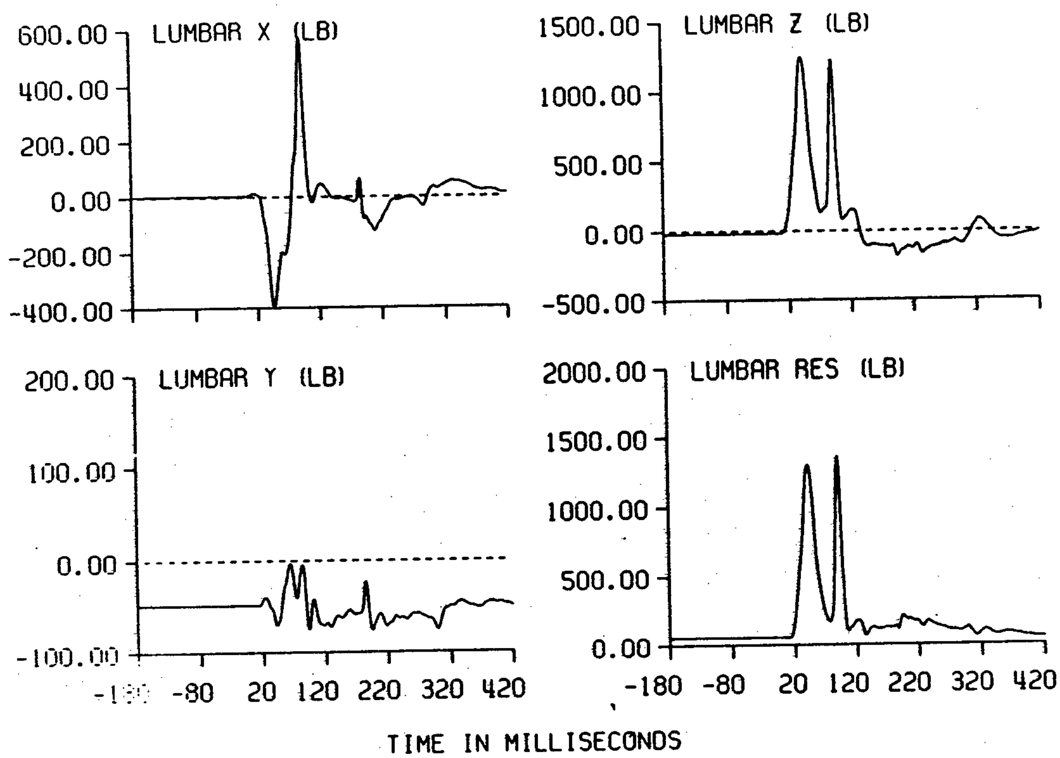
TIME IN MILLISECONDS

JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N

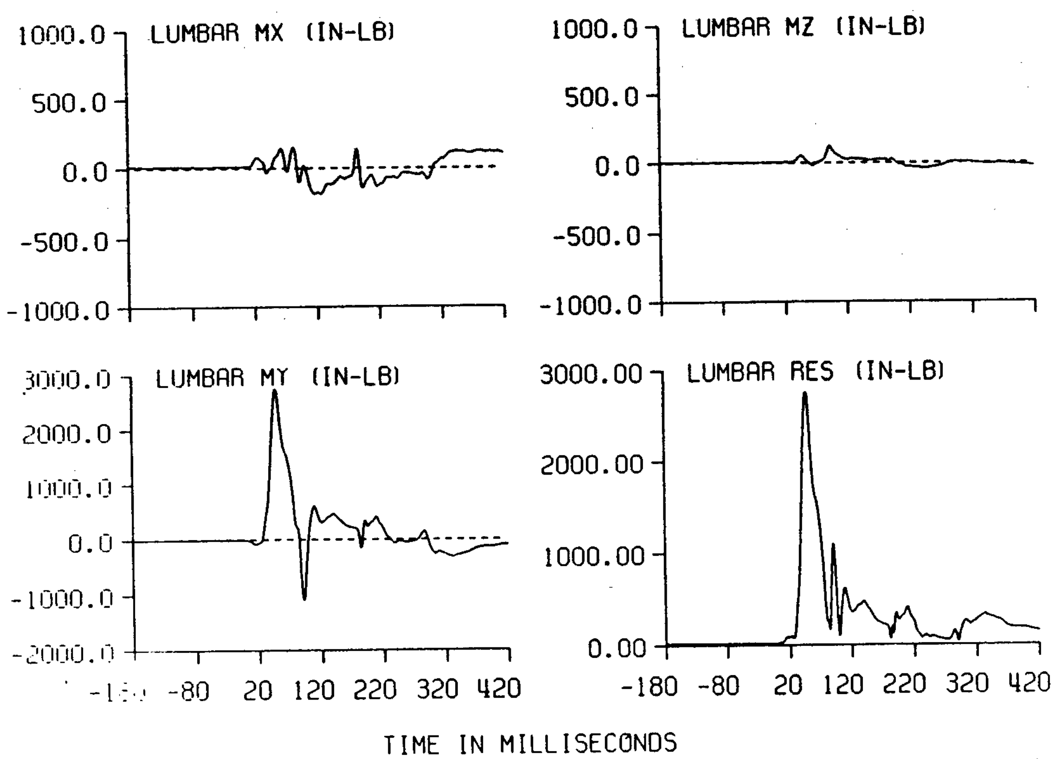


TIME IN MILLISECONDS

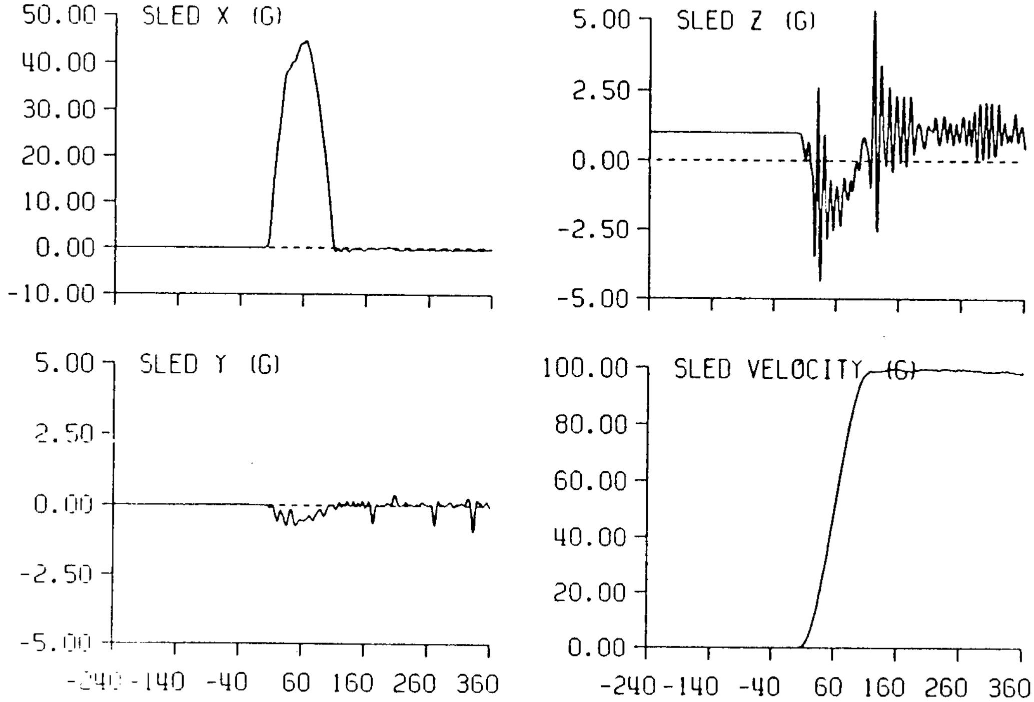
JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N



JPATS STUDY TEST: 5350 SUBJ: JPAT-S CELL: N

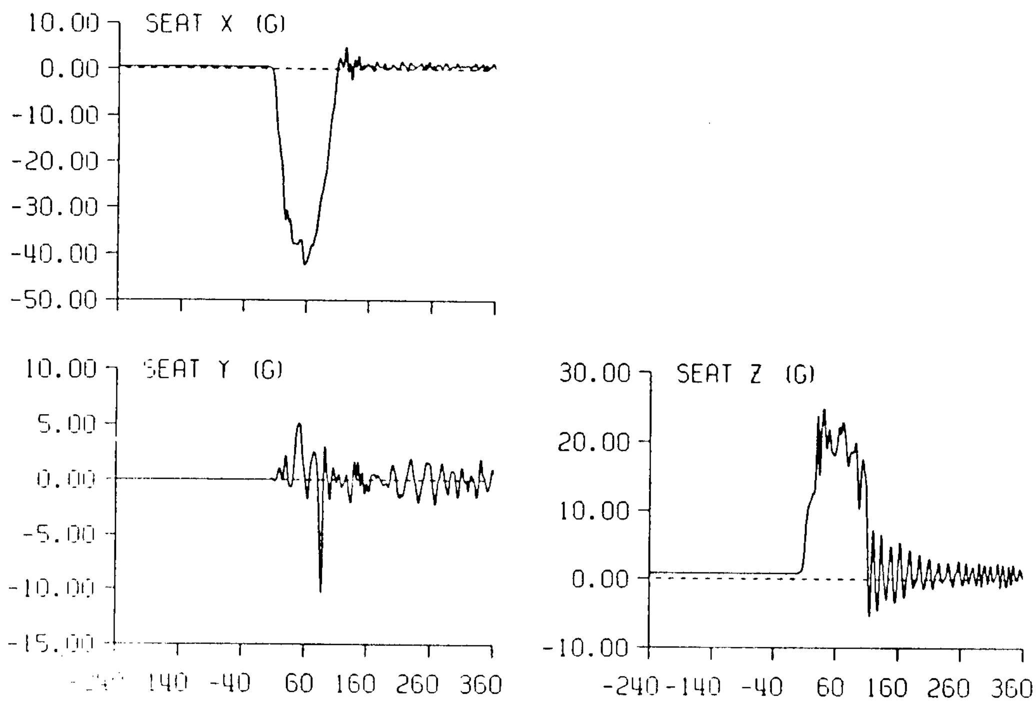


JPATS -GX STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



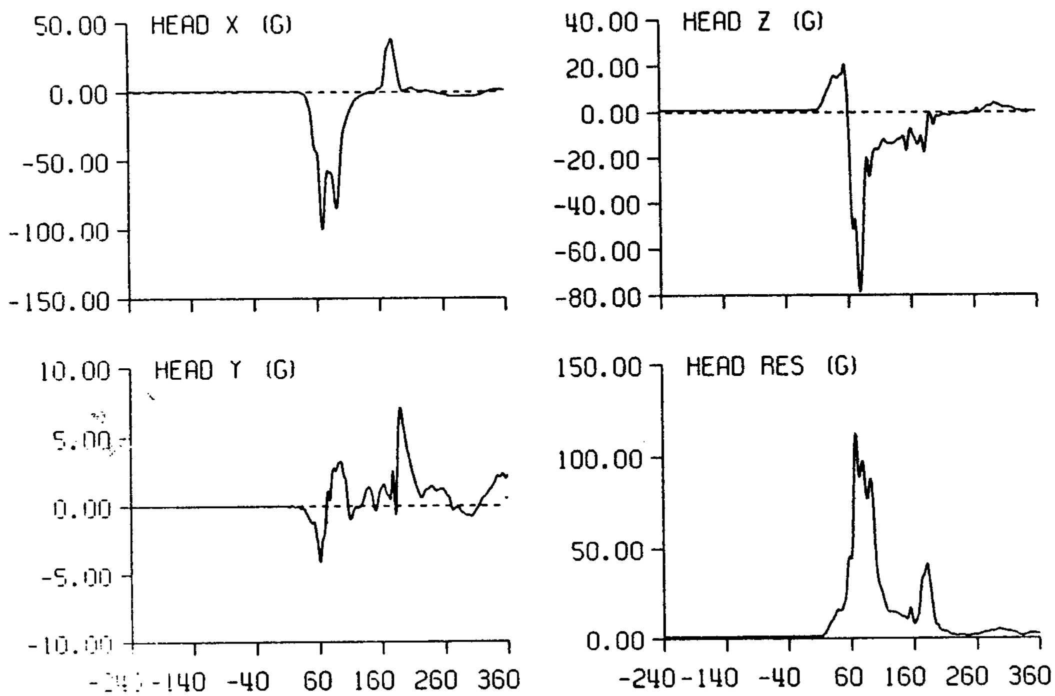
TIME IN MILLISECONDS

JPATS -GX STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



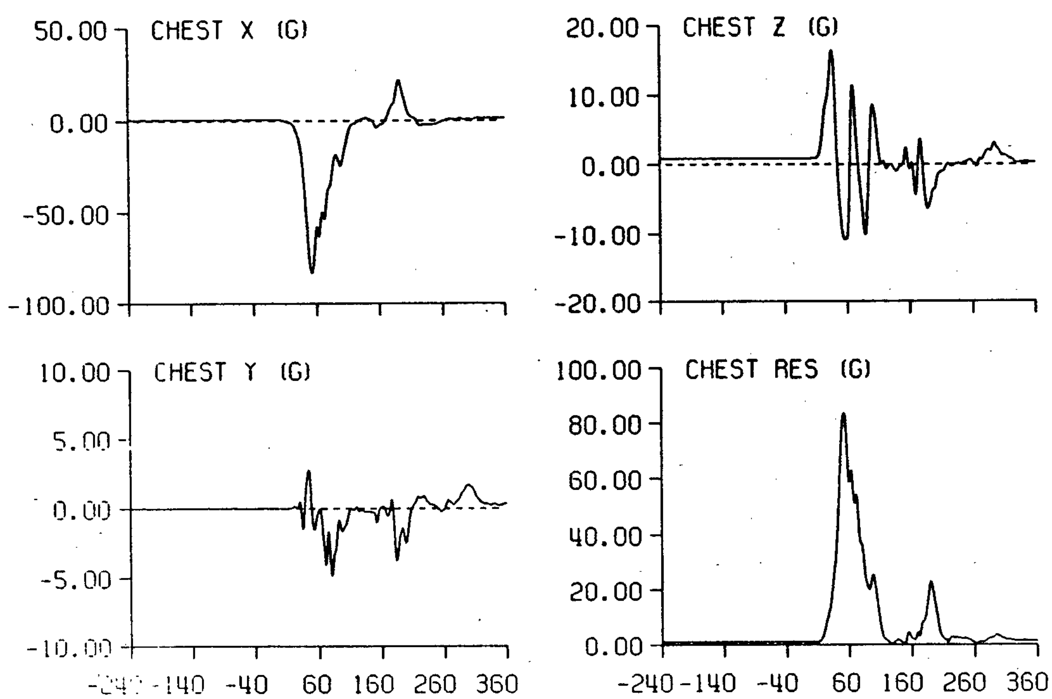
TIME IN MILLISECONDS

JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0

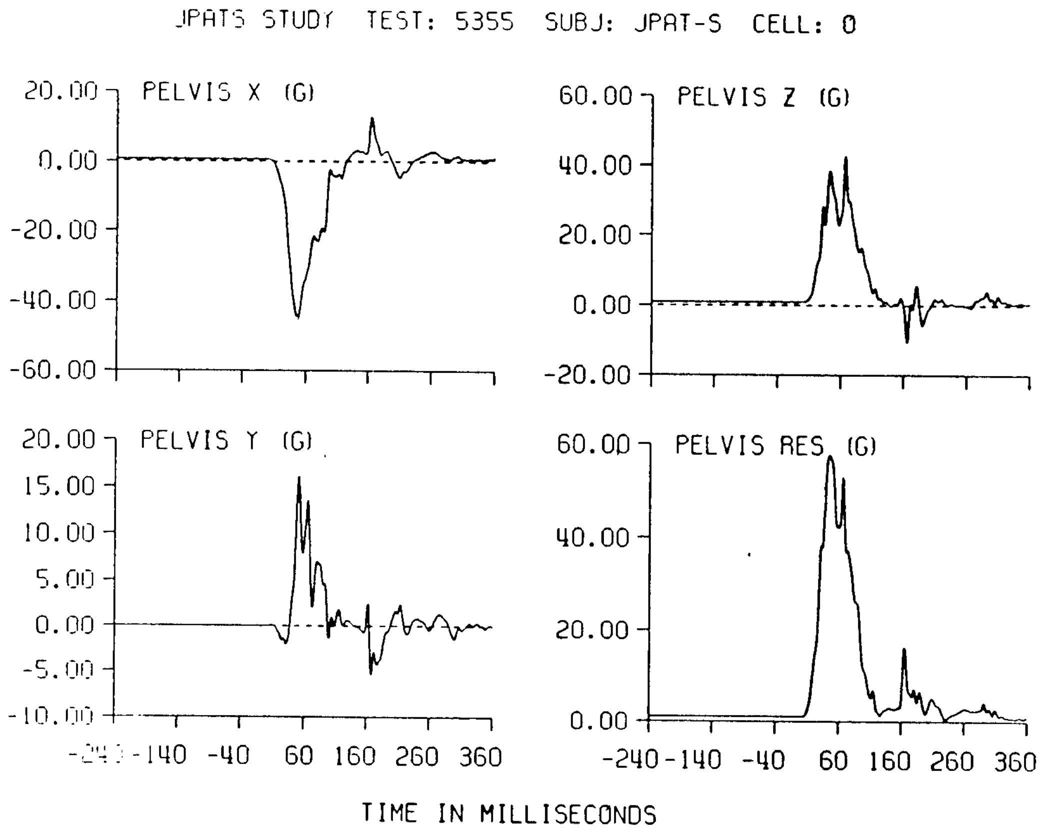


TIME IN MILLISECONDS

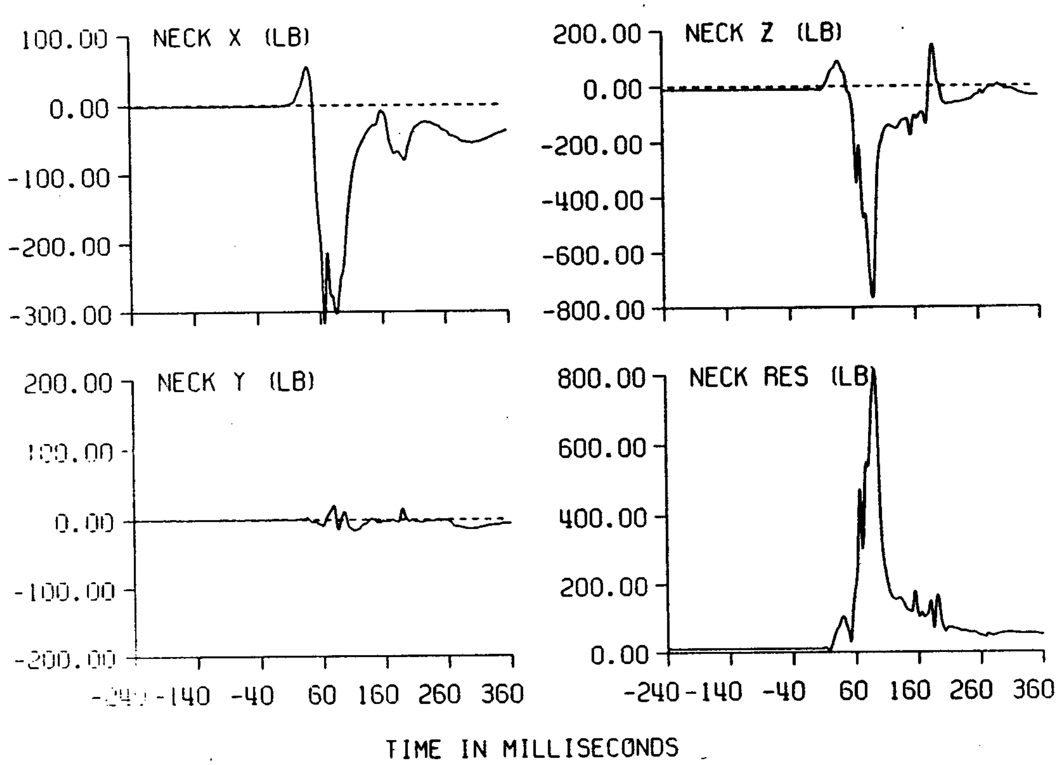
JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



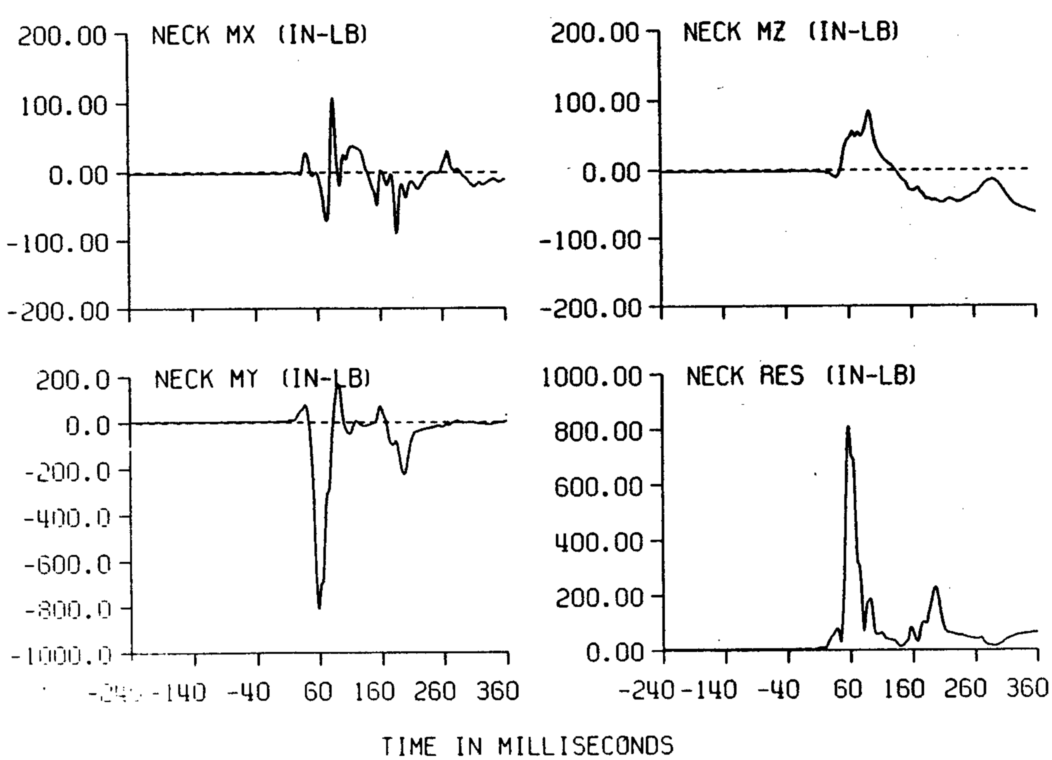
TIME IN MILLISECONDS


JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0
PELVIS X (G)
20.00
0.00
-20.00
-40.00
-60.00
PELVIS Z (G)
60.00
40.00
20.00
0.00
-20.00
PELVIS Y (G)
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
PELVIS RES (G)
60.00
40.00
20.00
0.00
-240 -140 -40 60 160 260 360
-240 -140 -40 60 160 260 360
TIME IN MILLISECONDS

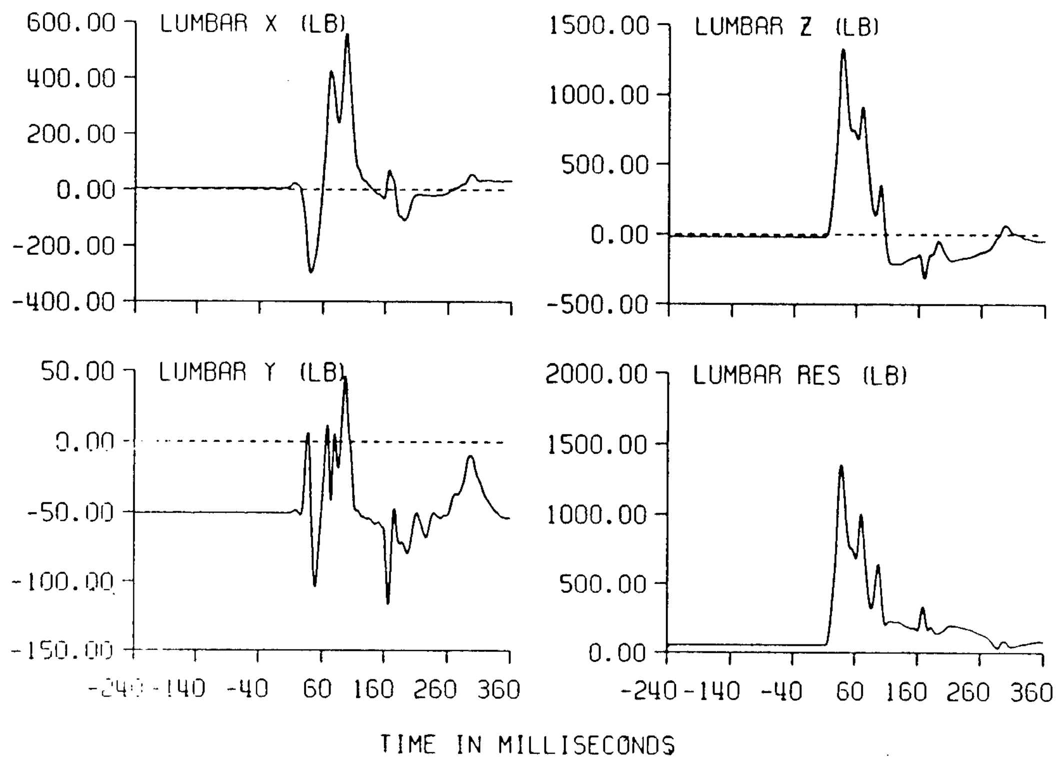
JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



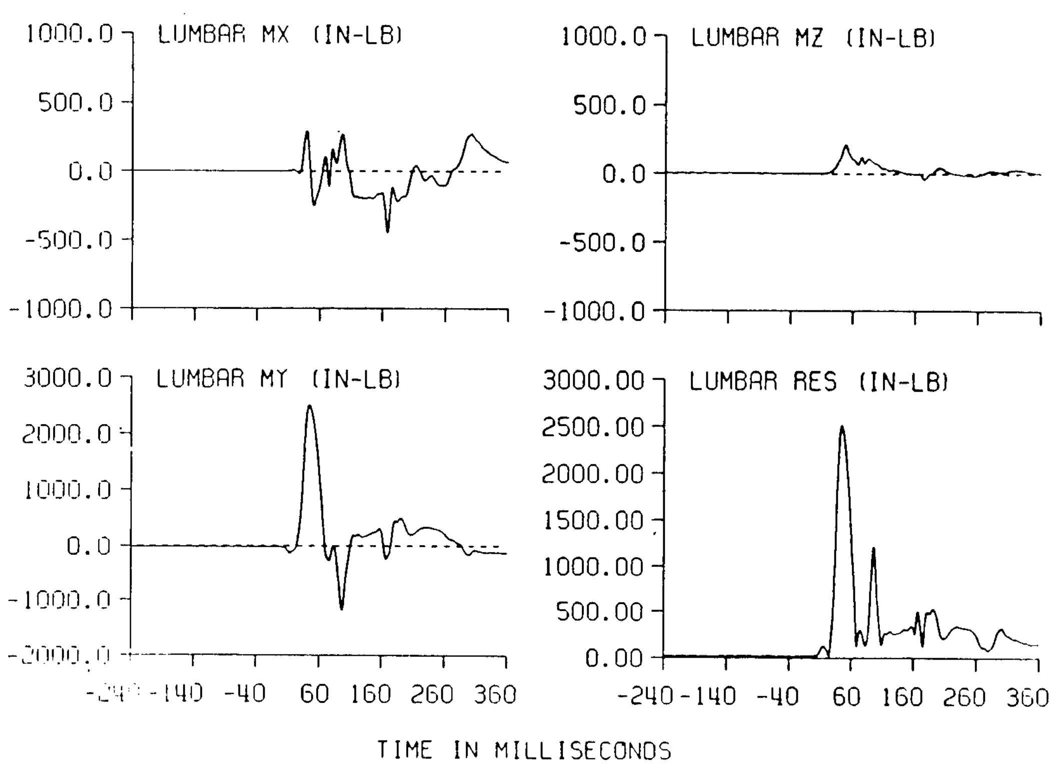
JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



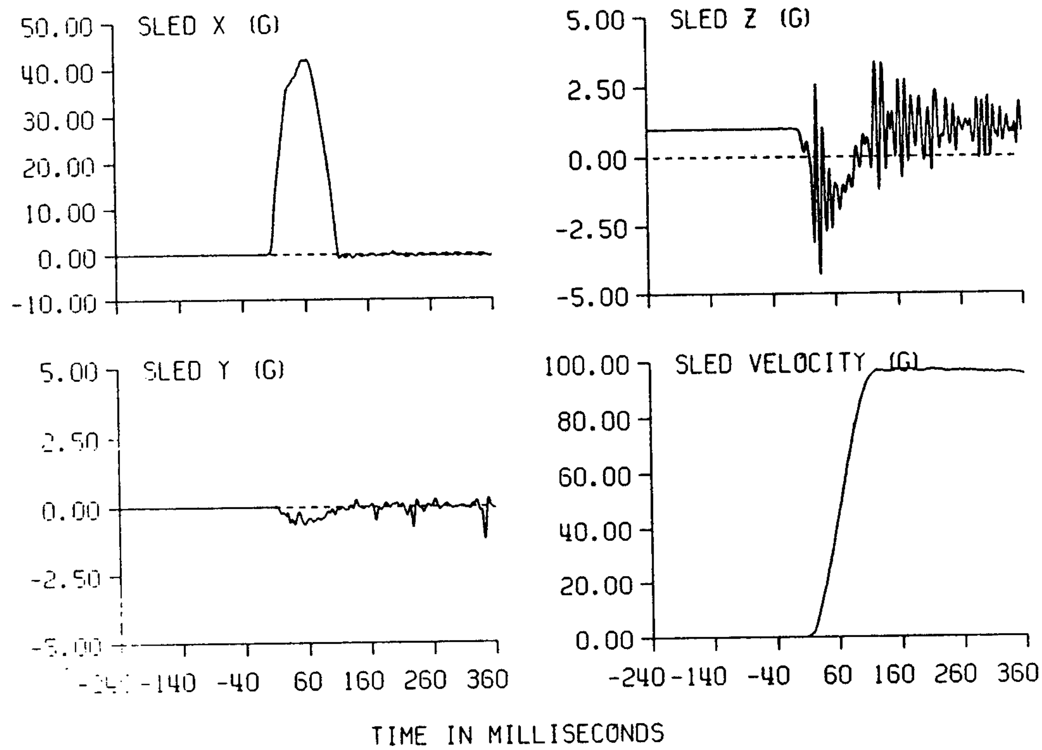
JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



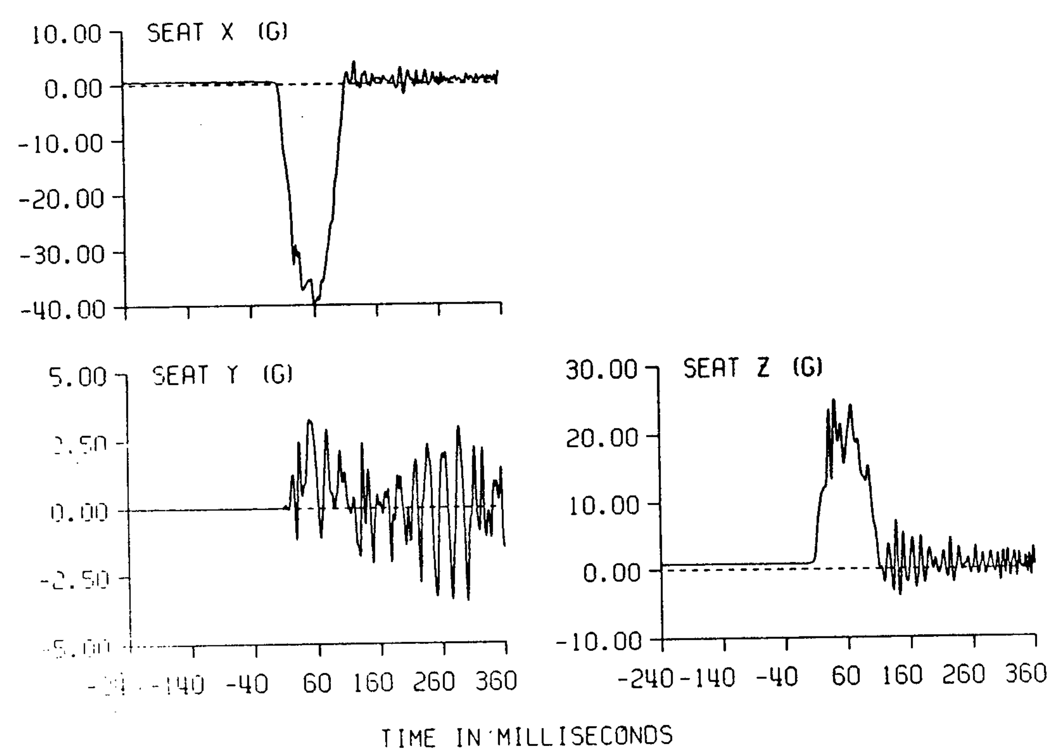
JPATS STUDY TEST: 5355 SUBJ: JPAT-S CELL: 0



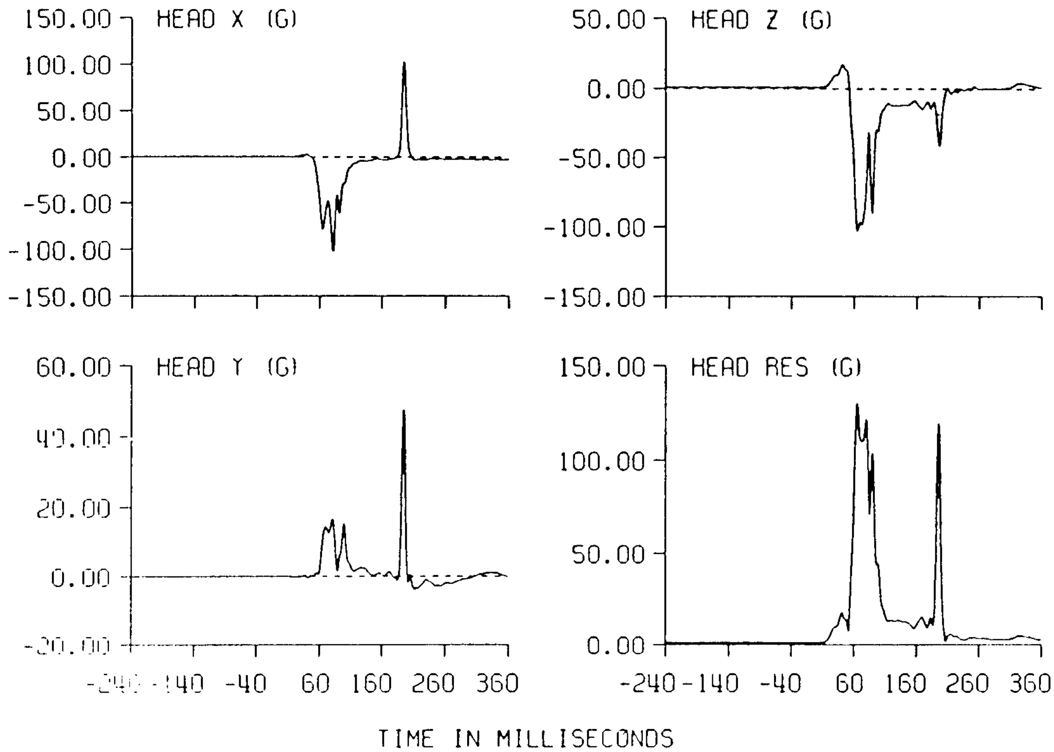
JPATS -GX STUDY TEST: 5354 SUBJ: JPAT-S CELL: P



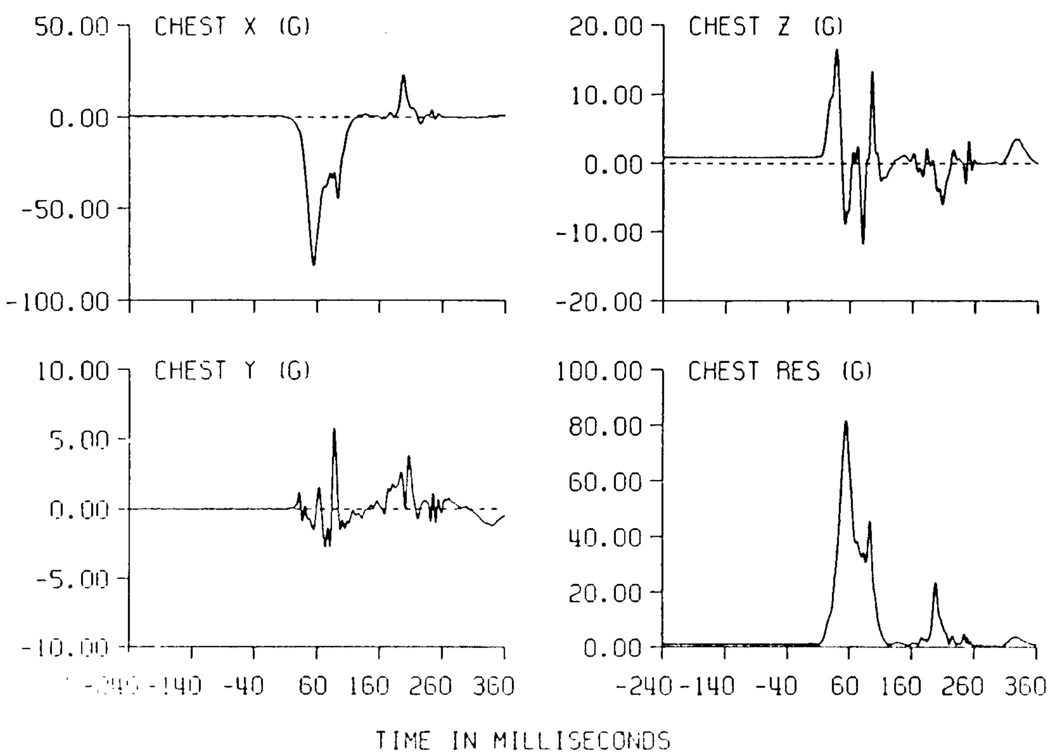
JPATS -GX STUDY TEST: 5354 SUBJ: JPAT-S CELL: P

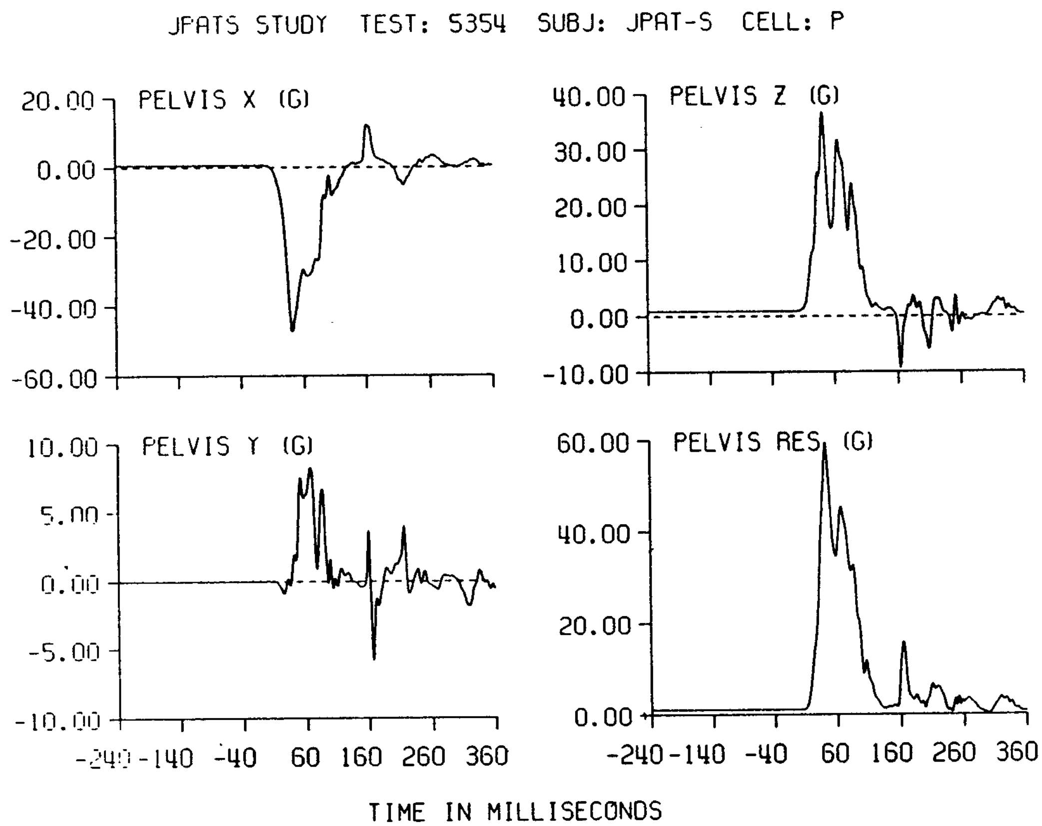


JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P

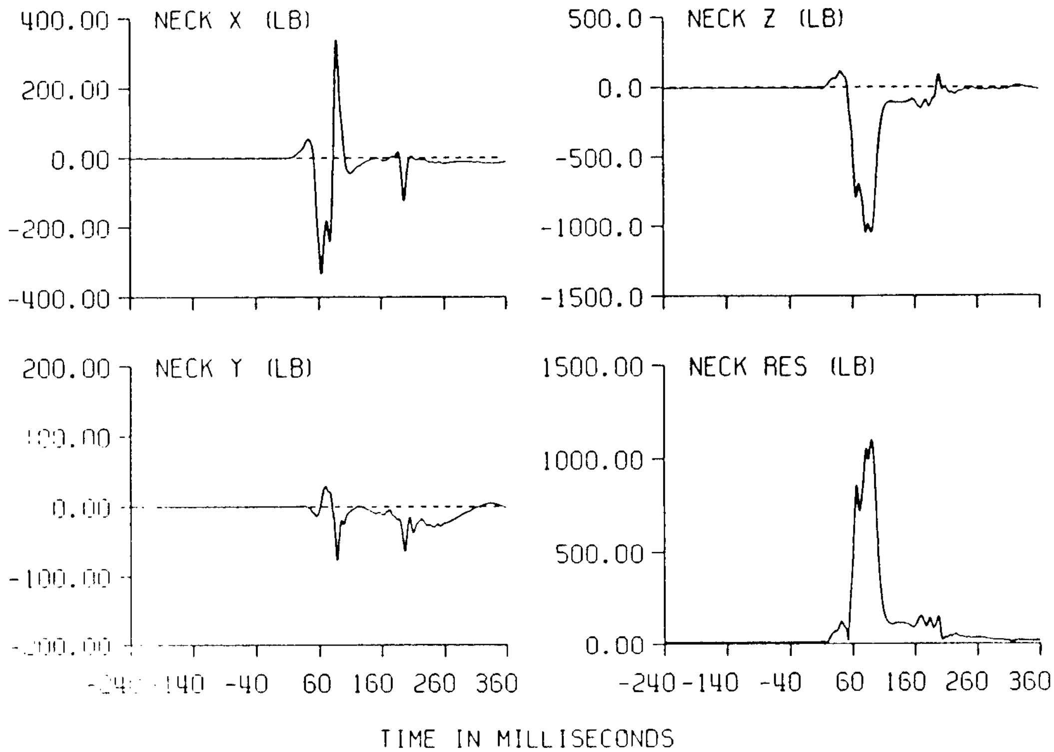


JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P

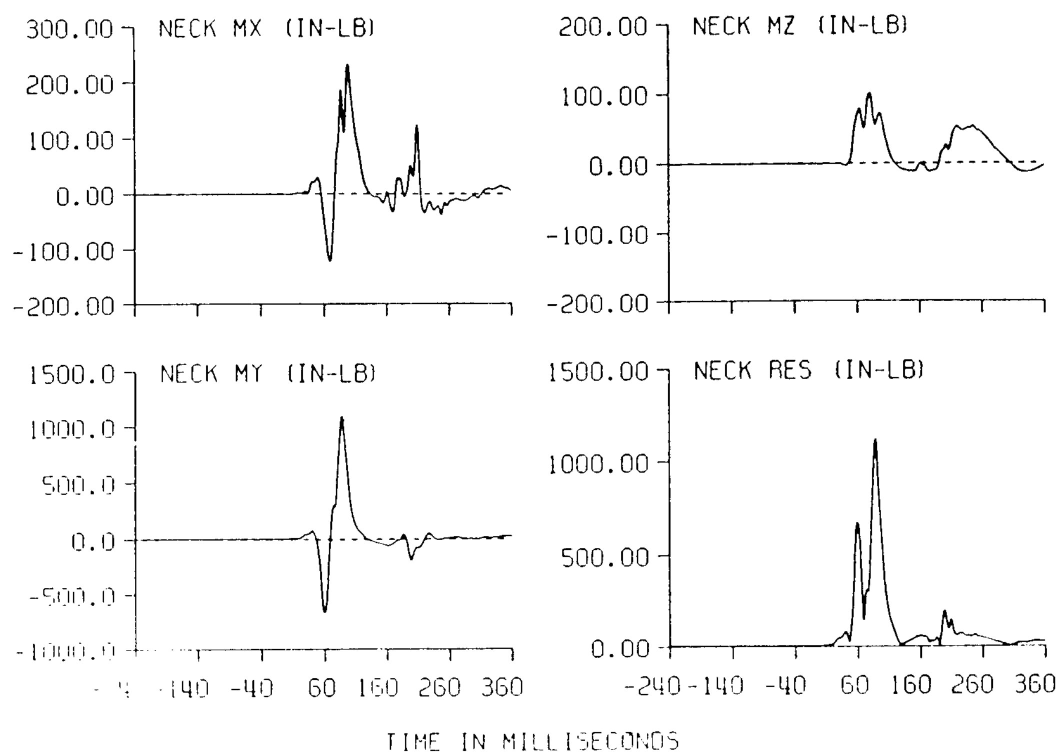



JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P
PELVIS X (G)
20.00
0.00
-20.00
-40.00
-60.00
PELVIS Z (G)
40.00
30.00
20.00
10.00
0.00
-10.00
PELVIS Y (G)
10.00
5.00
0.00
-5.00
-10.00
PELVIS RES (G)
60.00
40.00
20.00
0.00
-240 -140 -40 60 160 260 360
-240 -140 -40 60 160 260 360
TIME IN MILLISECONDS

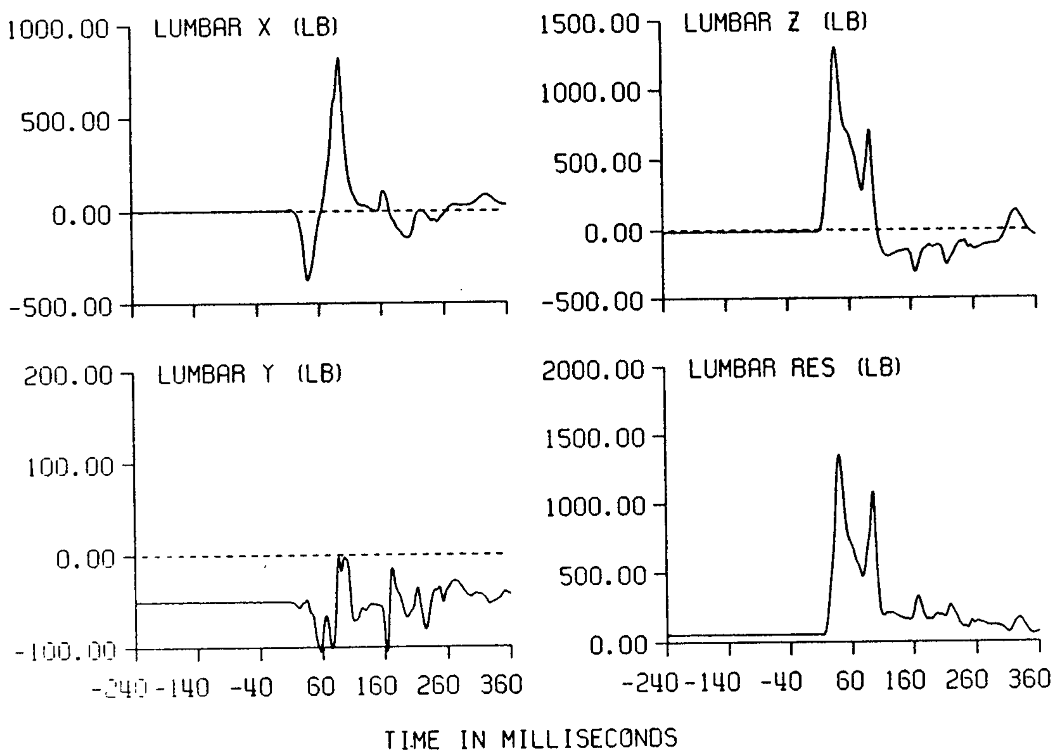
JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P



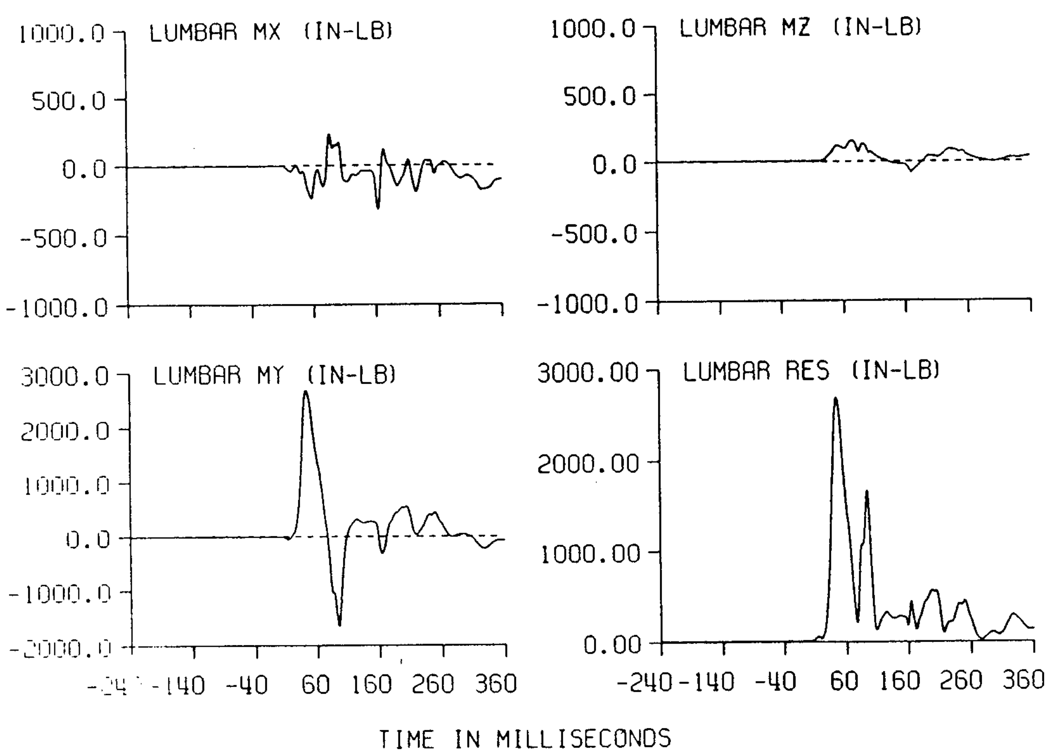
JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P



JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P



JPATS STUDY TEST: 5354 SUBJ: JPAT-S CELL: P



U.S. Government Printing Office 1996 750-071/40014